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WALTERS (E. A.). **Entomological Investigations.**—*Rep. Dep. Agric. St Lucia 1936* pp. 29–30. St. Lucia, 1937.

The successful establishment in St. Lucia is recorded of *Metagonistylum minense*, Tns., which was introduced in 1935 for the control of *Diatraea* spp. on sugar-cane. Puparia of the Tachinid were readily recovered on cane-stalks.

A species of *Strategus* was several times observed in coconut areas. Recommended measures of control are the destruction of dead palm trunks and precautions against wounding living palms.

HILL (C. C.) & EMERY (W. T.). **The Biology of *Platygaster herrickii*, a Parasite of the Hessian Fly.**—*J. agric. Res.* **55** no. 3 pp. 199–213, 11 figs., 12 refs. Washington, D.C., 1st August 1937.

Platygaster herricki, Pack., parasitises *Mayetiola* (*Phytophaga*) *destructor*, Say, in most of the sections of the United States where winter wheat is grown. It is important in the more southern parts of the eastern wheat-growing sections, in the central wheat belt west of the Mississippi, and in western Oregon. Several species of host are attacked. *P. herricki* is abundant in the south and west where *P. zosine*, Wlk., another important parasite of *Mayetiola*, does not thrive. All stages are briefly described, and the embryonic development is traced in great detail.

The two sexes of the parasite occur in approximately equal numbers, and parthogenetic reproduction produces males. The female oviposits in eggs of the host, and the eggs of host and parasite develop simultaneously. The female lays only one egg at each insertion, but frequently oviposits repeatedly in the same egg, or in an egg already parasitised by another female. Two or more first-instar larvae often occur in one host larva, but only rarely does more than one reach maturity. In a few instances, two adults, and in one case four pupae have developed in one host. The mature larva consumes most of the contents of the host, but not until the latter has formed its puparium. Its cocoon nearly fills the puparium. There is one generation a year. Adults emerge in the spring at the same time as those of *M. destructor* and oviposit, and the resulting larvae are full-grown by the end of the summer. The adult stage is reached before the winter, which is passed by the adults in cocoons within the host puparia. In Virginia in 1932, the percentages of hosts containing living *P. herricki* on 7th June, 17th August and 21st September were 20, 2.5 and 1, respectively. The heavy mortality was chiefly due to competition with Chalcidoid parasites of *M. destructor*, particularly *Eupelmus allyni*, French, and *Merisus destructor*, Say, and, to a much less extent, *Tetrastichus carinatus*, Forbes, and *M. febriculosus*, Gir.

ALLEN (M. W.) & PAINTER (R. H.). **Observations on the Biology of the Wheat-stem Maggot in Kansas.**—*J. agric. Res.* **55** no. 3 pp. 215–238, 5 figs., 30 refs. Washington, D.C., 1st August 1937.

Meromyza americana, Fitch (wheat stem maggot) is widely distributed through the wheat-growing area of the United States and Canada, frequently 10 and in some instances 100 per cent. of the plants in infested fields being attacked. Detailed studies of the life-history of this Chloropid [*cf. R.A.E.*, A **14** 472] were made in Kansas

in 1932 and 1933. In 1932, adults were caged on young wheat plants in the field, and after oviposition had occurred, sections of plants bearing eggs were placed in vials. In 1933, larvae were collected from wheat, barley, rye and grasses and placed in hollowed wheat stems in vials, and maggots were also reared from eggs secured in oviposition tests. The culms of 6,527, prematurely ripened, white heads of wheat were examined in 1933, and in 99.9 per cent. the injury was caused by *M. americana*. For oviposition tests, flies were caged in pairs, or several together, on wheat plants in pots or on young wheat out of doors.

All stages are described. Pairing may take place at any time during the first few days after emergence. The ratio of males to females is 11:9. In 10 females the preoviposition period varied from 2 to 6 days. Eggs are usually deposited singly on the leaf or leaf-sheath or occasionally between the leaf-sheath and the stem. In autumn, many eggs are found adhering to the stem just above the ground. Females laid an average of 10-15 eggs over a period of several days at the average rate of 1-4 daily. The incubation period lasted 4-11 days. The three larval instars lasted 2-11, 2-28 and 9-23 days, and the pupal stage lasted 5-20 days. In the case of 4 individuals reared from egg to adult, the period from hatching to adult emergence was 42-57 days.

The Chloropids overwintered as mature larvae. In 1933, these pupated in late March and early April, and adults emerged from mid-April to mid-May. Eggs were deposited during late April and the greater part of May, and began to hatch at the end of April. Larvae were found in the stems of wheat, rye and barley throughout May. They pupated at the end of May and in early June, and first-generation adults emerged from 5th to 28th June. They oviposited during the latter part of June and larvae hatched from 25th June to the end of July. They occurred in the stems of grasses and pupated from the middle of July till 8th August, and adults emerged until mid-August. Third-generation eggs were deposited on grasses and self-sown wheat during the latter half of July and the first half of August, and larvae hatched at the end of July and throughout the greater part of August. Many of them overwintered, but some third-generation adults emerged between the end of August and the beginning of October. Eggs were deposited, some of which hatched before 15th October, and the resulting larvae overwintered. Adults were present in the field until 16th December.

The newly-hatched larva makes its way down between the central shoot and its sheath, girdling the former, to its final feeding position at the base of the culm in autumn and early spring, and just above the upper node in late spring and summer. Most of the feeding is done within the central shoot. As the result of late spring and summer injury, the head dries prematurely and the grains, if present, are small and unfit for food or planting. In autumn and early spring, the flow of sap to the upper part of the leaf is interrupted, and whole tillers often die. Larvae were observed to feed on wheat, barley, rye, timothy (*Phleum pratense*) and two species of bristlegrass (*Setaria*). The cause of difference in the susceptibilities of various plots of wheat was studied and the greatest correlation was found between the amount of injury and the date on which about 10 per cent. of the plants headed. In 1933, most injury occurred when this date fell between 22nd and 26th May. Variety also influenced the amount of injury,

early varieties and early maturing lessening the damage by the spring brood.

During the experiments, 18 Hymenopterous parasites were reared, 3 from culms of white heads, 11 from self-sown wheat known to be heavily infested, and 4, *Coelinus* (*Coelinidea*) *ferruginea*, Gah., *C. (C.) meromyzae*, Forbes, *Microbracon meromyzae*, Gah., and a Cynipid of the genus *Hypodiranchis*, from puparia of *Meromyza americana*. The Cynipid has not been recorded in the literature as a parasite of *M. americana* and appears to be an undescribed species. The larvae of *Meromyza* appeared to be attacked by bacteria; a fungus, *Cladosporium* sp., was often found to be associated with the dead maggots, but most species of this genus are saprophytic.

CHRISTIE (J. R.). *Mermis subnigrescens*, a Nematode Parasite of Grasshoppers.—*J. agric. Res.* 55 no. 5 pp. 353-364, 6 figs., 5 refs. Washington, D.C., September 1937.

An account is given of the results of a study in Massachusetts of the bionomics of *Mermis subnigrescens*, Cobb, which has been found to parasitise 9 species of grasshoppers of 7 genera in nature, and 2 species of 2 other genera experimentally. It occurs throughout the New England States and westward to Minnesota, Iowa and Missouri, but is rarely found as far south as Washington, D.C. The eggs are deposited in summer on vegetation, to which they are attached by characteristic outgrowths or byssi. The grasshoppers swallow them while feeding and may contain 100 or more parasites of widely different ages. The larvae hatch within a few hours and make their way through the wall of the alimentary canal into the body cavity. The parasitic development of the larvae has not been worked out in detail. Males and females usually remain in the host for 4-6 and 8-10 weeks, and attain lengths of about 0.75-2.3, and 2-6 inches, respectively. The duration of the parasitic stage and size of the fully-grown larvae are, however, subject to great variation. The emergence of the fully-grown parasite results in the death of the host and of the younger parasites. A certain number of those that are nearly full-grown may, however, emerge and enter the soil, and some of these are able to complete their development. The Nematodes occur at various depths, down to about 24 inches, but are most abundant 6-18 inches below the surface. A final moult takes place in the following spring. Pairing occurs at least occasionally and has been observed several times. By July the females begin to show a brownish colour owing to the accumulating eggs, and by September they are nearly black, except for a short region at each end of the body. At this time the eggs are viable. Females emerge from the soil and oviposit at the beginning of June in the following year, but only during rain. A gravid female about $3\frac{1}{4}$ inches long may contain about 14,000 eggs. These are laid singly, or in masses of 25 or more, on any object over which the female passes, whether living foliage or dead branches, but are largely confined to herbaceous vegetation about 2 feet high. It was shown experimentally that most are laid 8-10 inches above the ground. The females probably do not survive another winter after oviposition, but they may live for several years if prevented from coming to the surface to oviposit. Some males and females that emerged from their hosts in September 1930 were buried in containers in the soil at the end of the month and were alive and apparently

healthy in May 1933. The females were full of eggs and there was no indication that any considerable number had been laid.

In addition to being eventually killed by the emergence of the parasites, infested female grasshoppers are usually sterile, but the males are less affected. In both sexes growth is materially retarded, infested individuals remaining in the nymphal stage longer than normal ones. In a number of collections, comprising altogether 2,500 grasshoppers from Massachusetts, New Hampshire and Connecticut, 12 per cent. were infested by Mermithids, the commonest being *M. subnigrescens*, though *Agameremis decaudata*, Cobb, Steiner and Christie, occurred in some numbers, and *Hexameremis* sp. in one collection. It is thought that *Mermis* and *Agameremis* are important in controlling outbreaks of grasshoppers, and that the former is the more valuable, as it is able to withstand a more variable environment and to maintain itself in larger numbers where the grasshopper population is consistently low. The distribution of both Nematodes is limited by low rainfall, but there are probably isolated regions where they do not occur and where climatic conditions are suitable for their establishment. Eggs of *M. subnigrescens* remain viable for months, and the artificial infestation of grasshoppers should be comparatively simple.

Large numbers of this Nematode may be collected by keeping infested grasshoppers in cages with a layer of soil on the bottom in which wheat may be grown. The death rate among the grasshoppers is usually high at first and results in the premature emergence of many Nematodes. If these are left in the soil for several weeks, many will die and additional abnormal specimens can usually be recognised and discarded. The soil must be kept moist at all times. The Nematodes thus collected should be buried in soil in containers; the soil should be sieved and should contain a certain amount of sand to facilitate subsequent sieving and the collection of the Nematodes. Their eggs may be collected in water by brushing them from foliage with a camel's hair brush and finally centrifuging to reduce the volume of water. Grasshoppers may be artificially infested by spraying the eggs with a small atomiser on to leaves, which are then transferred to the insect cages. The chief difficulty with this method is to prevent too great a number of eggs being swallowed, as superparasitism results in a great preponderance of males.

FLINT (W. P.) & others. **Entomology Investigations.**—*Rep. Illinois agric. Exp. Sta.* 49 (1935-36) pp. 143-171, 3 figs. Urbana, Ill., 1937.

This report deals with work on insect pests in Illinois in the year ended 30th June 1936. In experiments with barriers for preventing migration of chinch bugs [*Blissus leucopterus*, Say] from fields of small grains to maize, the best was a strip of tarred felt paper, 4 ins. wide, set 2 ins. deep in the soil. The strips are prepared by cutting 15 lb. rolls of paper into small 4-inch rolls, soaking them in creosote for 24 hours, and draining. They are left in position for the season and may be re-treated by pouring a narrow stream of creosote against the paper on the side next to the small grain. *Diabrotica duodecimpunctata*, F., destroyed most of the primary root system of at least 2,000,000 acres of maize in 1935. This damage and the subsequent rotting of the roots delayed growth so that early frosts reduced the quality of the crop and caused severe lodging. Experiments have shown

that some varieties are resistant. Certain hybrids that are most resistant to lodging after infestation are also resistant to the second brood of *B. leucopterus* and give a high yield of good quality grain. Infestation of maize by the corn root Aphid [*Anuraphis maidiradicis*, Forbes] was shown to be considerably reduced by the inclusion of clover in different rotations.

In experiments on the prevention of insect infestation of stored wheat, 2 oz. of different dusts were mixed with each bushel of grain and complete protection for one year was obtained with copper carbonate, copper phosphate, copper cyanide, hydrated lime, and 2 pyrethrum powders, one of which contained 0.95 per cent. pyrethrins. After one year's storage, all treated wheat germinated as well as, or better than, untreated grain. In extensive tests, 5 and 8 lb. Chorosol per 100 bushels oats in bins more than 8 and 50 feet deep, respectively, gave satisfactory control of insect pests in stored grain on farms. This commercial fumigant is non-inflammable, penetrates well, and has no disagreeable smell.

Infestation of peach by the oriental fruit moth [*Cydia molesta*, Busck] was more severe in 1935 than in any previous year, from 8 to 50 per cent. of the fruit being damaged. A bait of brown sugar attracted more than twice as many moths as one of molasses. In three years' tests, early sprays of 3 lb. lead arsenate and 6 lb. hydrated lime in 100 U.S. gals. water, followed by late sprays of wettable sulphur (4 lb. in 100 U.S. gals.), caused severe injury to the foliage and fruit. Only very slight injury was, however, caused by early sprays of 3 lb. lead arsenate, 8 lb. zinc sulphate and 8 lb. hydrated lime in 100 U.S. gals. water, followed by late sprays of wettable sulphur (5 lb.) or the zinc sulphate and lime without lead arsenate, and an excellent crop, relatively free from infestation, was produced. Early applications of dusts of lime, talc, lead arsenate and oil, 60 : 25 : 10 : 5, and late ones of sulphur, talc, lime and oil, 60 : 15 : 20 : 5, gave almost the same degree of control and did not injure the foliage or fruit. There was a percentage mortality of 99.4 and 100 in larvae of the codling moth [*Cydia pomonella*, L.] overwintering in orchard crates when these were dipped in tractor fuel kerosene alone and mixed with 5 per cent. monochloronaphthalene, respectively. An average of 4.7 moths per crate emerged from the controls. In experiments on adhesives for arsenical sprays, soy-bean oil (1-2 qts. per 100 gals.) greatly improved the spreading and sticking qualities of the spray and caused little if any injury to the foliage of apple [cf. *R.A.E.*, A 25 420]. The addition of soy-bean flour to arsenical sprays resulted in a smooth even film being deposited on the fruit, and preliminary tests indicate that this flour may also be useful as an emulsifier.

The severe winter of 1935-36 destroyed the San José scale [*Aonidiella pernicios*a, Comst.] on apple and peach over a large area of the State, rendering spraying unnecessary. In experiments on the control of the round-headed apple-tree borer [*Saperda candida*, F.], a solution of 2 lb. paradichlorobenzene in 1 U.S. gal. miscible oil, mixed with water at the rate of 1 and 2 oz. per U.S. pint and painted on the bases of apple trees, killed 27.2 and 61.9 per cent. of the borers, respectively. In further tests, 63 per cent. were killed by applications of 4 lb. paradichlorobenzene in 1 U.S. gal. miscible oil with sufficient water to make 2 U.S. gals. mixture. The trees were not injured in any of these tests [cf. 25 39]. A 5 per cent. oil emulsion applied during the dormant season to elms 15 ft. high was effective against the European

elm scale [*Gossyparia spuria*, Mod.], and it is thought that consistent annual spraying of trees isolated from re-infestation might eliminate this Coccid.

DAVIS (J. J.). **Insects of Indiana for 1936.**—*Proc. Ind. Acad. Sci.* **46** (1936) pp. 230–239. Indianapolis, Ind., 1937.

In this further paper of a series [cf. *R.A.E.*, A **25** 290], the weather conditions in Indiana from November 1935 to October 1936 and their effects on insect pests are discussed. The severe winter, when a temperature as low as -27°F . was recorded, weakened peach trees, which were then more liable to attack by *Scolytus rugulosus*, Ratz. The extreme heat and drought of the summer were favourable to some insects, such as *Cydia* (*Carposapsa*) *pomonella*, L., on apple and *Blissus leucopterus*, Say, which continues a menace to small grains and maize, but harmful to others, such as *Pyrausta nubilalis*, Hb.

There was an unusually heavy late autumn brood of *Mayetiola* (*Phytophaga*) *destructor*, Say, in 1935 in addition to the normal autumn brood. Although the late brood suffered a very high winter mortality, there were sufficient survivors from the normal autumn brood to produce a very heavy spring infestation in southern and western Indiana. The extreme heat and drought caused a high summer mortality of the puparia, and this, with the general late sowing of wheat, resulted in a light infestation in the autumn of 1936. A table is given showing the wheat yield and the loss in yield and value due to the fly for the 8 years 1929–36, the loss ranging from some £100,000 in 1931 to £560,000 in 1935, with an average yearly loss of nearly £300,000.

Paleacrita vernata, Peck, was more abundant and destructive than for many years, elms and unsprayed apple trees being defoliated. Other insects that attracted attention included the Noctuid, *Eriopyga cynica*, Gn., which attacked apple and peach buds and caused a loss of about £500 in one orchard, *Pulvinaria vitis*, L., on maple, *Gossyparia spuria*, Mod., and *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.) on elm, and *Lecanium fletcheri*, Ckll., on arbor-vitae [*Thuja*] in nurseries.

SORENSEN (C. J.). **Contribution to a Symposium on the Biology of Utah. Principal Insect Pests of Cereals, Forage, and Orchard Fruits in Utah.**—*Proc. Utah Acad. Sci.* **13** pp. 219–223, 19 refs. Provo, Utah, 1936. [Recd. November 1937.]

Lists are given of the principal insect pests of cereals, forage crops and fruit trees in Utah, with notes on the abundance and damage caused by the most important. Some of them have been noticed previously [*R.A.E.*, A **19** 69; **21** 513; **23** 654]. *Porosagrotis orthogonia*, Morr., has been injurious to wheat since 1916, and was particularly so in 1934, 1935 and 1936. *Chlorochroa sayi*, Stål, appeared suddenly in large numbers in 1932 and damaged cereals and forage and seed crops of lucerne; in 1935 most of the western half of the State was severely infested and it was estimated that in one district the yield of grain was reduced by 50 per cent. *Lygus elisus*, Van D., and *L. hesperus*, Knight, are probably the most abundant pests of lucerne, but it is periodically severely injured by *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.), which practically destroyed about 1,000 acres in one district in April 1934, and suffered from a local outbreak of *Loxostege sticticalis*, L., in 1932. *Hylastes* (*Hylastinus*) *obscurus*, Marsh., causes much damage to the roots of clover every year in one district.

SORENSEN (C. J.) & GUNNELL (F. H.). **Type of Injury caused by Lygus Bugs to maturing Peach Fruits. Preliminary Studies.**—*Proc. Utah Acad. Sci.* **13** pp. 225–227, 8 refs. Provo, Utah, 1936. [Recd. November 1937.]

In order to find the type of injury to peach fruits caused by *Lygus hesperus*, Knight, and *L. elisus*, Van D., which are sometimes abundant on peaches in Utah, particularly in orchards with a cover crop of lucerne, sweet clover or grasses, experiments were carried out by enclosing 1, 2, 4 or 8 of the bugs for about 20 days on individual maturing fruits. The amount of injury caused to the fruits was in direct proportion to the number of bugs on them. All fruits showed feeding punctures, and those exposed to 4 bugs had brownish corky areas on the inner surface of the skin beneath the punctures. Fruits exposed to 8 bugs were somewhat reduced in size, and the cell structure surrounding the punctures had completely collapsed and become brown, dry and corky, the corkiness extending approximately $\frac{1}{8}$ in. into the fruit. Fruits from the control cages or from the orchard were not injured in this way.

SORENSEN (C. J.) & ANTHON (E. W.). **Preliminary Studies of *Acrosternum hilare* (Say) in Utah Orchards.**—*Proc. Utah Acad. Sci.* **13** pp. 229–232. Provo, Utah, 1936. [Recd. November 1937.]

Brief descriptions are given of the egg and adult of *Acrosternum hilare*, Say, which in Utah attacks the fruits of cherry, apricot, peach, grape-vine and pear in turn as they ripen. In 1935 it infested peaches in one district from June until mid-September. It injured the early varieties most severely, and caused about 20 per cent. of the crop to be rejected. Cage experiments were carried out to determine the nature of the injury, which is described in detail. Depressions were usually formed on the surface of the fruit, and the flesh beneath was injured; fruits severely infested when young dropped from the tree, and those moderately infested were deformed. Pairing was first observed in mid-June, and in the experimental cages the oviposition period extended from 21st June to 5th September. In the field, eggs were generally placed on the leaves, but also on the fruit and twigs. Females laid 6–114 eggs singly or in clusters deposited at intervals of about 7 days. The nymphs hatched in 5–14 days and passed through 5 instars. Development from egg to adult was completed in 58–82 days, so there is probably only one generation in the year. Adults were found hibernating under old curled oak-leaves at a distance of 50–80 yards from the orchards.

KNOWLTON (G. F.). **Biological Control of the Beet Leafhopper in Utah.**—*Proc. Utah Acad. Sci.* **14** pp. 111–139, 7 figs., 31 refs. Provo, Utah, 1937.

An account is given of the natural enemies of *Eutettix tenellus*, Bak., in Utah, where it still causes varying degrees of damage to beet and is sometimes a major pest of tomatos, beans and cucurbits. Dissections showed that the percentages attacked annually by internal parasites in the five years from 1929 to 1935 varied from 1.39 to 4.4. Ten species of *Pipunculus* were taken in association with *E. tenellus* in northern Utah [cf. *R.A.E.*, A **25** 88], parasitism being highest in 1935 and lowest in 1933. The larvae appeared to be able to survive the winter within the body of the host. The other parasites were

Dryinids, the larvae of which mature within the body of the host, emerging to pupate on the foliage of the plant, and Stylopids, including *Agalliaphagus* sp. In one locality in 1935, parasitism by Dryinids reached 22 per cent., but it was generally much lower. Some individuals of *E. tenellus* were infested by mites.

The chief predacious Rhynchota [cf. **24** 67] were *Nabis fesus*, L., and *Geocoris decoratus*, Uhl., which are most important in the sugar-beet fields and the desert breeding grounds, respectively, and *N. alternata*, Parshley, which also occurred on many desert breeding grounds. Detailed descriptions are given of the methods of attack of these three predators, and tables show the numbers of *E. tenellus* consumed by them in cages. Under such conditions, *N. alternata* compared favourably with *N. fesus*. Other species preying on *E. tenellus* in the field included *G. pallens*, Stål, *Zelus socius*, Uhl., *Lygus elisus*, Van D., and *L. hesperus*, Knight; *G. atricolor*, Montd., and *N. roseipennis*, Reut., accepted leafhoppers in cage experiments.

Notes are given on the importance of predatory lizards in the natural control of *E. tenellus* [cf. **23** 33, etc.], with the results of the examination of their stomach contents. Of 713 birds of 22 species collected in 1934-36, 195 contained 2,570 individuals of *E. tenellus* [cf. **23** 180; **24** 67].

KNOWLTON (G. F.). **Utah Birds in the Control of certain Insect Pests.**—*Proc. Utah Acad. Sci.* **14** pp. 159-166, 1 fig. Provo, Utah, 1937.

The results are given of the examination of the stomach contents of birds belonging to 53 species taken in Utah from 1934 to 1936. It is concluded that birds consume large quantities of injurious insects, which more than compensates for the injury caused by a few of the species. The number of parasitic and predacious insects found in the stomachs was very small compared with the number of injurious ones. Turkeys and to a less degree fowls are of definite use in controlling heavy infestations of grasshoppers or the Mormon cricket [*Anabrus simplex*, Hald.].

KNOWLTON (G. F.). **Some Potato Insects of Utah.**—*Proc. Utah Acad. Sci.* **14** pp. 151-154, 1 fig. Provo, Utah, 1937.

KNOWLTON (G. F.). **Pea Insects of Utah.**—*T.c.* pp. 167-169, 1 fig.

Brief notes are given on the numerous insects that have been observed to attack potatoes and peas in Utah and on measures for the control of a few of them. In 1936, 13,000 acres of peas for canning were seriously injured by *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.), which may be controlled by a spray of 3 lb. derris or cubé dust containing 4 per cent. rotenone, with $\frac{1}{2}$ lb. non-alkaline wetting agent, in 100 U.S. gals. water, applied at the rate of 175 U.S. gals. per acre under a pressure of at least 300 lb. *Hippodamia convergens*, Guér., *H. quinquesignata*, Kby., and *H. parenthesis*, Say, fed on the Aphids in different parts of the affected areas.

BAILEY (S. F.). **The Bean Thrips.**—*Bull. Calif. agric. Exp. Sta.* no. 609, 36 pp., 10 figs., 2 pp. refs. Berkeley, Calif., June 1937. [Recd. November 1937.]

A detailed account is given of the bionomics of *Hercothrips fasciatus*, Perg., in California, with notes on its distribution elsewhere, descriptions of all stages and a list of the plants on which it occurs. Much

of the information has already been noticed [*R.A.E.*, A 21 590]. The development of its control by means of insecticides is reviewed from the literature. In preliminary field tests of dusts, including nicotine, cryolite and barium fluosilicate, a dust of 50 per cent. pyrethrum (containing 0.5 per cent. pyrethrins) with 325 mesh sulphur gave the best control of the thrips on beans, and one of 10 per cent. cubé (containing 5 per cent. rotenone) with 325 mesh sulphur was almost as good. In another locality the same pyrethrum dust gave better control than cryolite on lima beans. In a third locality where initial infestation of the thrips on lima beans was higher, dusts of 50 per cent. pyrethrum with diatomaceous earth, cryolite with sulphur, cryolite alone and pyrethrum alone were effective in that order. As well as acting as repellents, the pyrethrum mixtures killed many of the larvae that hatched during the 5 days after application. Control by means of sprays or dusts on crops such as peas, beans and cotton is difficult in practice, because the presence of the thrips is not noticed until the leaves begin to dry up and fall, when infestation is already severe, and two or three applications of insecticides at intervals of about a week are necessary to kill the larvae and adults emerging from eggs and pupae, which are not affected. Weed growth near the fields and orchards is generally a source of infestation, and in large areas of contiguous plantings of beans or cotton all the prickly lettuce (*Lactuca scariola*) and annual sow thistle (*Sonchus oleraceus*) in the neighbourhood should be destroyed. The numbers of larvae per bean leaf were counted at points situated at measured distances from the margins of fields in cases where weed control was and was not practised. The average seasonal reduction of the infestation caused by weed control was 83.1 per cent. Under certain conditions, overhead irrigation keeps the thrips in check; but fields irrigated by ditches may show considerable damage. Observations in the field have shown that beans of the kidney type are more severely injured than lima beans. Varieties of beans are classified as to observed susceptibility, but as infestations can be largely prevented or controlled by good cultural methods, extensive breeding to develop resistant varieties is not likely to be necessary.

ECKERT (J. E.) & MALLIS (A.). **Ants and their Control in California.**—*Circ. Calif. agric. Exp. Sta.* no. 342, 37 pp., 26 figs., 6 refs. Berkeley, Calif., July 1937. [Recd. November 1937.]

This circular contains a general account of the habits of ants in California, the damage caused by them and methods for their control. Notes are also given on the appearance and habits of some 27 species and varieties and on the individual measures applicable against the more injurious of them, together with a key for their identification. The control of *Iridomyrmex humilis*, Mayr, is dealt with in some detail [cf. *R.A.E.*, A 24 770; 25 180, etc.]. A list is appended of materials and formulae used, and of antidotes and emetics for use in case of poisoning by any of the insecticides recommended.

HOUSER (J. S.). **The Wheat Field Survey for 1937. The Black Wheat-stem Sawfly.**—*Bi-m. Bull. Ohio agric. Exp. Sta.* 22 no. 188 pp. 142–146, 4 figs. Wooster, Ohio, 1937.

In 1937, infestation of wheat in Ohio by the Hessian fly [*Mayetiola destructor*, Say] was lower than it had been since 1929 and averaged

only 4.3 per cent. In one locality in south-eastern Ohio, 8 per cent. of the wheat straws showed evidence of damage by larvae of *Sphenophorus (Calendra) minimus*, Hart. The black wheat-stem sawfly [*Trachelus tabidus*, F.] occurred over a wider area than in 1936 [cf. *R.A.E.*, A 25 15]. It appeared to be less abundant, but careful examination showed that 70 per cent. of the straws were infested in some fields. The wheat, however, did not show characteristic lodging, as the straws were particularly vigorous. Many straws were cut at some height above ground level, and a smaller number than usual were completely severed, even where the harvest was delayed.

GOOD (N. E.). **Insects found in the Milling Streams of Flour Mills in the southwestern milling Area.**—*J. Kans. ent. Soc.* 10 no. 4 pp. 135–148, 6 figs., 1 ref. McPherson, Kans., November 1937.

In 1932 and 1934–35, eight-ounce samples of flour were collected monthly from each of 24 elevator boots and other mill streams in 19 flour mills in Kansas, Oklahoma and Missouri, and the insects in each sample were counted and recorded. The relative abundance and frequency of occurrence of the different species in 17 of the mills in 1934–35 are discussed, the numbers being greatly influenced by methods of control. Tables and charts show the numbers found in the mills in different districts and in the different mill streams, as well as seasonal fluctuations in the populations of the species or genera concerned. At least 30 species, distributed among 25 genera, were found. In 17 mills *Tribolium* spp. comprised 84.65 per cent. of the insects collected, while *Ephestia kuehniella*, Zell., which was formerly the most injurious flour-mill pest, was very scarce. Of 74,175 insects recorded, 99.85 per cent. were Coleoptera.

MUNDINGER (F. G.) & HARTZELL (F. Z.). **The Pear Midge : Orchard Studies and Experiments for its Control.**—*Tech. Bull. N.Y. agric. Exp. Sta.* no. 247, 75 pp., 36 figs., 32 refs. Geneva, N.Y., August 1937.

A detailed account is given of work carried out for 11 seasons on the seasonal history of *Contarinia pyrivora*, Riley, on pear in New York and its control by sprays and dusts [cf. *R.A.E.* A 19 352, 404]. Previous literature on control methods is reviewed. The experiments were carried out in a number of orchards in western New York and the Hudson Valley, and phenological data for the most important of these are shown in a series of charts. The results are expressed in numerous tables.

The following is taken from the authors' summary: The injury caused by the pear midge is confined to the young fruit. In cases of severe infestation up to 90 per cent. of the pears may be destroyed, but generally the loss is from 25 to 50 per cent. where protective treatments are not given [cf. 25 235]. The period for effective control by sprays seldom exceeds 4 days, and, during some seasons, may be as short as 24 hours. The investigation has established the fact that in New York treatment should be given when the majority of the flies are present, but before egg-laying is effected. At this time very few of the blossom buds show much separation of the sepals. Correct timing of the applications is the most difficult feature of pear-midge control [25 235].

Nicotine dusts were not very effective in any of the experiments conducted, and were not practical during many seasons owing to high winds at the critical period. Effective results were usually secured with nicotine sulphate at the rate of $\frac{3}{4}$ –1 U.S. pint in 100 U.S. gals. spray mixture containing one of the following materials: lime-sulphur, $2\frac{1}{2}$ or 11 U.S. gals.; summer oil emulsion, 1 or 2 U.S. gals.; Bordeaux mixture (2:10:100); soap, 3 lb., or neutral soap, 3 U.S. pints. Tests with molasses and nicotine sulphate gave unsatisfactory results. Ground tobacco (1–1½ per cent. nicotine content), 30–35 lb. in 100 U.S. gals. water, gave results comparable to nicotine sprays, but some difficulties were encountered in its use, such as lack of suspension and the occasional clogging of the spray machine, particularly the valves. The experiments indicate that summer oil emulsion at the rate of 2 gals. actual oil in 100 gals. spray material is almost as effective as a mixture containing 1·7 gals. actual oil with $\frac{3}{4}$ pint nicotine sulphate in 100 gals. A thiocyanate (Lethane) appears promising for the control of this insect. The number of applications of any mixture necessary for control depends on the condition of the buds and the length of the egg-laying period. With all materials, two treatments were more effective than one in seasons when oviposition continued over a period of 4 or more days.

HOSKINS (W. M.). **The Absorption of Selenium by Citrus and by Grapes.**—*Science* **87** no. 2246 pp. 46–47, 3 refs. New York, 14th January 1938.

Tabulated results are given of analyses for selenium of fruits from plots that had been treated for several years for the control of *Tetranychus pacificus*, McG., on grape-vines and *Paratetranychus citri*, McG., on *Citrus* with a potassium ammonium selenosulphide (Selocide) [cf. *R.A.E.*, A **21** 565] and from neighbouring untreated plots. The usual dilution was 1:600 on vines and 1:800 on *Citrus*. All *Citrus* fruits were washed in dilute nitric acid to remove adhering selenium. Soil samples were taken at the edge of the trees or vines where the run-off of spray was heaviest.

The selenium content in parts per million was about 0·25 in all untreated soils tested, and was always less than 1 in soils of plots sprayed up to 6 times. In the skin and pulp of sprayed *Citrus* fruits it averaged 0·21 and 0·06 as compared with 0·10 and 0·05 in those of unsprayed *Citrus* fruits. It was over 0·6 in grapes from vines sprayed during the current year, but was much less when the sprays were applied in previous years only.

WATSON (J. R.). **Additional Notes on *Naupactus leucoloma*.**—*Florida Ent.* **20** no. 2 pp. 22–25. Gainesville, Fla., October 1937.

Observations on *Naupactus leucoloma*, Boh., which has recently caused severe damage to field crops in Florida [*R.A.E.*, A **25** 700], were continued in the summer of 1937. This weevil was found to be parthenogenetic, no males being produced, and the possibility of its dispersal is, therefore, greatly increased. The adults began to emerge in mid-June and appeared to reach their maximum numbers on 10th July. In some fields, there were as many as 400,000 per acre. During the heat of the day they sheltered under leaves, but late in the afternoon, or earlier if it was cloudy, they began to crawl actively over the ground, sometimes at the rate of 4 feet a minute, and lay their eggs. These were

deposited in the ground, if it was not too hard, or on sticks or stones. They are covered with a gelatinous material to which grains of sand adhere, rendering them very inconspicuous.

The adults appeared to have a more restricted range of food-plants than the larvae [*cf. loc. cit.*]; ground-nuts and cotton were the chief cultivated plants attacked. They often migrated from fields in which the food-supply was exhausted; this habit and the extent of the damage caused is illustrated by the history of two adjacent fields on an infested farm. One of these had been planted with ground-nuts in 1936 and the crop had been a complete loss owing to infestation, but after it had been replanted with the same crop in 1937, only a few larvae were found. They were, however, so abundant in an adjoining field of maize, about 4 acres in extent, that not one ear was produced, and only a few suckers were left standing. By the middle of July, the ground was perforated with the exit holes of the adults, but these were very scarce, most of them having migrated back to the ground-nuts, where they were ovipositing. The adults may be trapped in furrows ploughed round infested fields, especially if post holes are dug a few feet apart along the bottom of the furrows. Pigs and fowls feed readily on them, but where they are abundant, very large numbers of poultry would be necessary to eliminate them.

Notes on the occurrence of this weevil in New South Wales [*cf.* 21 303] are quoted from a letter received from W. B. Gurney. It has only been found in the Northern Table Lands, 250 miles north of Sydney, where the larvae attack the roots of lucerne. There, as in Florida, the winter is passed in the larval stage in the soil. It is of interest that, both in Australia and the United States, this introduced weevil appeared in a restricted inland area; in the United States, however, it has recently been found in two localities, one on the coast, in Mississippi.

CHAMBERLIN (F. S.) & MADDEN (A. H.). **Progress Report on Dusts containing Rotenone for the control of Flea Beetles attacking shade-grown Cigar-wrapper Tobaccos.**—*Florida Ent.* 20 no. 2 pp. 25-29, 1 fig., 2 refs. Gainesville, Fla., October 1937.

Dusts containing rotenone are of established value in the control of flea-beetles attacking shade-grown cigar-wrapper tobaccos, especially the types grown in northern Florida and southern Georgia, where the species concerned is *Epitrix parvula*, F., and in the Connecticut Valley, where it is *E. cucumeris*, Harr. Cubé and derris are apparently equally effective [*cf. R.A.E.*, A 24 432], but cubé is almost exclusively used, owing to its lower cost. The main advantages of these dusts over the insecticides previously used are speed of action, safety to the crop, and absence of objectionable residue; their main disadvantage is the short duration of their efficiency.

In an experiment a cubé dust mixture containing 1 per cent. rotenone gave 74 per cent. mortality of adults of *E. parvula* after it had been exposed to sunlight in a thin film for 24 hours; under field conditions it would probably remain toxic for about 3 days. In field tests against this beetle in Florida, 5 applications of dusts containing 1.5, 1.0 and 0.5 per cent. rotenone were made at the rate of 7 lb. per acre during the season, and the percentage of injured leaves was reduced from 75.2 in the controls to 20.5, 31.9 and 44.1, respectively. The 1 per cent. dust should give satisfactory control if applied in the evening, early

morning or late afternoon, as it is more effective under moist than under dry conditions. Applications to newly set and mature plants should be at the rate of 4-5 and 8-10 lb. per acre, respectively. Finely ground Georgia clay, kaolin or diatomaceous earth may be used as diluents, but, to avoid discoloration, sterilised tobacco dust should be substituted in dusting mature crops.

Cubé is not toxic to grasshoppers and is of little use against *Protoparce* spp. and *Heliothis virescens*, F. Grasshoppers are killed by barium fluosilicate dust, which is also effective against *E. parvula*, but which, under certain weather conditions, scorches the tobacco leaves [21 245].

SEVERIN (H. C.). *Zodion fulvifrons* Say (Diptera : Conopidae), a Parasite of the Honey Bee.—*Ent. News.* 48 no. 9 pp. 243-244, 1 ref. Philadelphia, Pa, November 1937.

On 1st October 1936, about 150 bees were forwarded from a hive in South Dakota to the author, who found that at least 50 per cent. were parasitised by the Conopid, *Zodion fulvifrons*, Say. The bee-keeper stated that only the workers were affected, although drones were numerous in the hive, and that the healthy bees carried the weakened parasitised ones from the hive and dropped them on the ground. All the bees received had died in transit, but the Conopid larvae were apparently mature on arrival and pupated within 1-3 days. The larvae were found only in the abdomen of the host and generally occurred singly, though occasionally two were found together. Pupation took place within the abdomen, except in one case where the larva ruptured the intersegmental membrane and the pupa projected between two segments. The puparia were kept at 70-80°F. in a glass rearing jar containing moist sand, and all the flies emerged within 2-3 weeks. The species was identified by D. G. Hall, who stated that it has also been recorded as a parasite of the honey bee in Texas and Connecticut. The author has taken 5 adults in South Dakota in August. Some species of *Physocephala*, another Conopid genus, are also parasitic in honey bees.

SWAIN (R. B.). The Parasites of the Fall Webworm. *Hyphantria cunea* Drury (Lep. : Arctiidae).—*Ent. News* 48 no. 9 pp. 244-248, 21 refs. Philadelphia, Pa, November 1937.

This list of the parasites of *Hyphantria cunea*, Dru., infesting deciduous trees in the United States and Canada, comprises 19 Tachinids, and 29 primary, 15 secondary and 1 tertiary Hymenopterous species. The hosts of the last two groups are given. Of 15 species reared by the author in Colorado, 9 are recorded from *Hyphantria* for the first time.

Service and Regulatory Announcements, April-June, 1937.—S.R.A., B.E.P.Q. no. 131 pp. 89-205. Washington, D.C., U.S. Dep. Agric., September 1937.

Existing regulations under Quarantine 52 provide that baled cotton lint produced in a regulated area lightly infested with the pink bollworm [*Platyedra gossypiella*, Saund.] in the United States may be moved to non-regulated areas after compression, roller treatment or fumigation under vacuum. A further alternative treatment is here

approved. Baled cotton lint produced from cottonseed grown in the area may be so moved if the cottonseed has been heated to a temperature of at least 155°F. in approved apparatus under the supervision of an inspector and subsequently handled so as to prevent contamination. Such treatment must be given separate from ginning operations and removed from other contaminated products.

An announcement relating to Quarantine no. 61 [R.A.E., A 14 628] against the thurberia weevil [*Anthonomus grandis thurberiae*, Pierce] provides that cottonseed may be moved from the regulated areas if it has been sterilised to 145°F. as part of the continuous process of ginning, and in addition has been treated by sulphuric acid and screening, and subsequently has been protected from contamination in a manner satisfactory to the inspector.

Other matter in this part includes summaries of plant-quarantine restrictions issued by Sweden, Belgium, Austria, Yugoslavia, Greece, Malta, Egypt, Algeria, Morocco, Fernando Po & Spanish Guinea, the Belgian Congo, Northern and Southern Rhodesia, Persia, the Seychelles, the Gilbert & Ellice Islands, British Honduras, Costa Rica, Guatemala, the Republic of Honduras, Nicaragua, Panama, Salvador, British Guiana, Montserrat, St. Vincent, Barbados and St. Lucia, as well as amendments to summaries already noticed of restrictions issued by Great Britain, Rumania, Malta and Argentina.

CAMPBELL (L. W.). **Experiments to control Sugar Beet Leafhopper, 1936.**—*J. econ. Ent.* **30** no. 5 pp. 687-688. Menasha, Wis., October 1937.

Field demonstrations were carried out in 1936 in California on the control of the sugar-beet leafhopper [*Eutettix tenellus*, Bak.] with atomised oils, a method that has been used commercially for five years [cf. R.A.E., A 21 474, 593]. In all cases a mixture of oils and 4 per cent. of a 20:1 pyrethrum extract [equivalent to 20 lb. pyrethrum flowers to 1 U.S. gal. kerosene] was used. An application at the rate of 4.1 U.S. gals. per acre was made by aeroplane in the early morning in an 80-acre field of beet in various stages of development in central California. The temperature was 65°F., and wind was blowing at 8 miles an hour. The number of females per plant (4.28) was reduced by 87.8 per cent. 6 hours after spraying. An application by aeroplane at the rate of 5 U.S. gals. per acre, made in a field in a district near the coast in the afternoon with a temperature of 84°F., gave a control of 97.6 per cent. An application under the same conditions by means of a ground-vaporising machine gave 98.2 per cent. control.

In these atomised sprays, the oil of the kerosene type that is the carrier of the pyrethrum or other toxic material requires the addition of a white neutral oil to give satisfactory atomisation, retard evaporation of the kerosene and minimise the risk of injury to plants. The necessary proportion of white oil varies with the type of atomiser and method of atomisation and should be determined by experiment in each case.

BULGER (J. W.). **Feeding predetermined Doses of Poison to Silkworms.**—*J. econ. Ent.* **30** no. 5 pp. 689-693, 3 figs., 7 refs. Menasha, Wis., October 1937.

A method is described for administering predetermined doses of poisonous dusts to leaf-eating insects, in order to determine the median

lethal dose. It is a modification of the leaf-sandwich method [R.A.E., A 18 311 ; 20 417] and is called the inlay sandwich method. It was tested on fourth-instar larvae of the silkworm [*Bombyx mori*, L.]. A small disk carrying the desired dose is removed by a special cutter from a dusted leaf and inserted into the hole in a larger disk of untreated leaf from which a piece of the same size has been removed. The whole is then covered with another untreated disk smeared with starch paste. Three-quarters of the sandwich is covered by two pieces of cardboard held by a clamp, and the remaining quarter, including the treated part, exposed to the insect. This reduction of the exposed area increases the probability that the insect will consume the entire dose. It was found necessary to inlay the treated disk, because, if it were merely stuck on to the surface of a piece of untreated leaf, the silkworm usually refused to eat it.

The method is best suited to the more toxic insecticides, which do not require a heavy deposit of dust on the inlay. It is estimated that, in practice, the average errors of the original sandwich method and the inlay sandwich method would be about equal.

FROST (S. W.). **Tests of Baits for Oriental Fruit Moths, 1936.**—*J. econ. Ent.* 30 no. 5 pp. 693–695. Menasha, Wis., October 1937.

In 1936, tests were conducted in Pennsylvania with 40 chemicals in baits for adults of *Cydia* (*Grapholitha*) *molesta*, Busck [cf. R.A.E., A 25 33]. Glass jars were again used as traps. Some of the chemicals were first dissolved in alcohol and some emulsified with acacia ; those that were readily soluble in water were added directly to the baits. All were used at the rate of 1 cc. or 1 gm. per trap. The population of *C. molesta* was generally low throughout the season, its distribution was uneven, and catches were too low for satisfactory conclusions to be drawn. The 10 best materials in descending order were : oleic acid, U.S.P. ; terpinyl acetate ; safrol ; eugenol ; oleic acid, linolic free ; oleic acid, commercial ; tartaric acid ; linolic acid ; sodium oleate ; and acetone, U.S.P. Acetic acid, anethol, anisic aldehyde and linseed oil were tested [cf. *loc. cit.*], but were not among the 10 best, the last three giving comparatively poor results. Some materials were observed to be more attractive at one season of the year than another. Most of the materials are inexpensive, but linolic acid is too costly for practical use.

WALKDEN (H. H.). **Life History Notes on *Eriopyga incincta* (Morr.) in Kansas.**—*J. econ. Ent.* 30 no. 5 pp. 695–699, 1 fig., 1 ref. Menasha, Wis., October 1937.

An account is given of observations in Kansas on the bionomics of *Eriopyga incincta*, Morr., which attacks cereal and forage crops in the middle-west of the United States, but only occasionally causes noticeable damage. Its range extends from Illinois to the Pacific coast. All the larvae collected by the author were taken under debris along roadside hedges or in grass where *Hordeum pusillum* predominated. In captivity, they fed sparingly on lucerne and wheat leaves, but preferred the kernels of sprouted wheat. There is one generation a year in Kansas, the adults occurring in September. In captivity, females laid their eggs singly just beneath the surface of the soil or on the surface. The egg stage lasted 8–32 days according to temperature.

The larvae feed to some extent in late autumn and overwinter when partly grown. A limited amount of feeding occurs during mild periods throughout the winter months. Feeding is resumed in March or early April, and practically all the larvae are full-grown by mid-May. They enter the soil and pupate before the end of the month. Of the 102 larvae taken over a period of several years in southern Kansas, 8 per cent. were killed by fungous diseases and 11 per cent. by internal Hymenopterous parasites.

Section of Extension.—*J. econ. Ent.* **30** no. 5 pp. 705–715, 1 ref. Menasha, Wis., October 1937.

This section includes a paper entitled Value of Co-ordinating Extension Entomologists and the Bureau in conducting Insect Control Campaigns, by P. N. Annand (pp. 705–710), in which an account is given of the organisation in the United States of large-scale campaigns for the control of insect pests by the Bureau of Entomology and Plant Quarantine, in co-operation with individual states; and one entitled Intensive Demonstrations in Cotton Flea Hopper Control, by R. R. Reppert (pp. 712–715), in which a description is given of demonstrations in Texas on the control of the cotton flea-hopper [*Psallus seriatus*, Reut.] by dusting with sulphur.

ANNAND (P. N.). **The Alfalfa Snout Beetle.**—*J. econ. Ent.* **30** no. 5 pp. 715–721, 2 refs. Menasha, Wis., October 1937.

An account is given of the part taken by the Bureau of Entomology and Plant Quarantine in investigating the status of *Otiorrhynchus* (*Brachyrrhinus*) *ligustici*, L., in New York, where it was found feeding on raspberries in 1933 [*R.A.E.*, A **21** 476] and where it now infests a large range of food-plants, the larvae being chiefly injurious to lucerne and clover. Its bionomics and food-plants of economic importance and methods of controlling it are reviewed, mainly from the literature [*cf.* **23** 465, 557; **25** 179], and the danger of its spreading to other areas is discussed.

FENTON (F. A.) & MAXWELL (J. M.). **Flat-headed Apple Tree Borer in Oklahoma.**—*J. econ. Ent.* **30** no. 5 pp. 748–750, 1 fig. Menasha, Wis., October 1937.

The Buprestid, *Chrysobothris femorata*, Ol., is one of the most serious pests of shade and fruit trees in Oklahoma, where it is particularly injurious to elm, apple and pecan trees, and rose bushes. Dry weather and unfavourable soil conditions have increased its importance in recent years. During the autumn and winter of 1935, large numbers of injured branches and small trees, most of which contained larvae deep in the heartwood, were collected and kept exposed to normal conditions. They were caged in the following spring and an account kept of the number of adults that emerged each day. In all, 669 emerged, between 4th May and 29th June. In nature, in central Oklahoma, adults were observed flying from 20th April to 9th October, 51 out of 67 collection records being for June. The beetles were placed for study in glass cages in sunny positions in a greenhouse with apple and elm cuttings as food. They fed readily on the bark of one-year-old cuttings, especially in crotches and around

bud scars, but not on the leaves. On the second or third day after emergence, they started drumming by vibrating the abdomen rapidly against the surface on which they were resting, and pairing occurred soon afterwards. The preoviposition period was 4–8 days, and was prolonged by shortage of food. Beetles that were not fed lived for only a few days. Eggs were deposited on the sunny side of the branches, chiefly in cracks. Individual females laid 21–166 eggs, and the average number of eggs laid each day by all the females varied from 0 to 69 and was closely correlated with temperature. Several individuals lived for 40 days, and one for 44. Other Coleoptera reared from the caged material included the Clerids, *Chariessa pilosa*, Först., and *C. pilosa onusta*, Say, which were predacious on adults and larvae of *Chrysobothris femorata*. About 6.9 per cent. of the larvae collected in the winter and spring of 1936 had been attacked by a Hymenopterous parasite.

EYER (J. R.), MEDLER (J. T.) & LINTON (H. L.). **Analysis of Attractant Factors in fermenting Baits used for Codling Moth.**—*J. econ. Ent.* **30** no. 5 pp. 750–756, 2 figs., 17 refs. Menasha, Wis., October 1937.

The authors criticise the methods used in the past in testing the attractiveness of fermenting baits to the codling moth [*Cydia pomonella*, L.] because they were not directed to the identification of the attractive principle. They accordingly conducted further tests, using an olfactometer. Ethyl oxyhydrate (probably an impure form of ethyl acetate) and several oxyhydrates made with other alcohols and vinegar proved more attractive than the same series made with glacial acetic acid. Methyl and ethyl esters of various acids were also compared, and the esters of succinic and benzoic acids were found to be the most attractive. These results may be correlated with the facts that succinic acid is formed in relatively large amounts in fermentation products and that sodium benzoate has a stimulating effect in baits [*R.A.E.*, A **19** 547]. Pure cultures were made of 7 bacteria that had been isolated from a syrup during the process of fermentation under normal conditions. Preliminary tests showed that cane-sugar solutions fermented through the action of pure cultures of most of these bacteria were slightly more attractive than the same baits allowed to ferment through inoculation by the mixed flora from the air.

BYNUM (E. K.). *Pseudococcobius terryi* Fullaway, a Hawaiian Parasite of Gray Sugarcane Mealybug in the United States.—*J. econ. Ent.* **30** no. 5 pp. 756–761, 3 refs. Menasha, Wis., October 1937.

Pseudococcobius terryi, Fullaway, was introduced into the United States from Hawaii in 1932 [*R.A.E.*, A **20** 697] for the control of *Pseudococcus boninsis*, Kuw. (grey sugar-cane mealybug). Several hundred individuals were released in Louisiana, Georgia and Florida in that year and additional releases were made in 1934 and 1936 in the same states. The parasite is known to be established in all three states, though not in all the plantations in which liberations were made. In addition to intentional releases, it is spread by the movement of seed cane infested with parasitised mealybugs. It certainly exercises some control, but it is difficult to estimate how much.

The male is more active than the female, but both crawl rapidly. Both sexes flew readily in the laboratory, but only for short distances. Females were observed to oviposit in all stages of the host with the possible exception of the first-instar nymph. In several instances, a female parasite, isolated with a host, oviposited twice with an interval of less than 5 minutes. In rearing experiments in the laboratory, the time from host exposure to the emergence of the parasite ranged from 16 to 40 days, the averages for winter, spring and autumn, and summer being 33, 28 and 18 days. The maximum number of parasites to emerge from a single adult female *Pseudococcus* confined with a single *Pseudococcobius* was 19 and the average 8.5. Females oviposited readily in mealybugs from *Tetrapanax papyrifera*, which were determined by H. Morrison as the *Pseudococcus citri*, Risso, of authors, and several parasites apparently normal in size and activity were reared. Parasites emerged at the end of 30 days from *P. boninsis* collected from standing cane in the field 4 days after the temperature had dropped to 24°F., and recoveries were made in the summer following an exceptionally cold and wet winter. An outside temperature of 20°F. did not seem to affect adult parasites confined in a tube covered by one thickness of thin cloth and placed near a north window of a frame laboratory building.

NICKELS (C. B.). **Experiments to control Pecan Nut Casebearer in Texas, 1936.**—*J. econ. Ent.* **30** no. 5 pp. 761-763. Menasha, Wis., October 1937.

Sprays of 6 lb. lead arsenate per 100 U.S. gals. and of 12.8 fl. oz. nicotine sulphate with 3 U.S. qts. summer oil emulsion per 100 U.S. gals. were tested for the control of the first generation of *Acrobasis caryae*, Grote (pecan nut case-bearer) in two localities in the semi-arid central and south-western parts of Texas in 1936. Zinc sulphate (2 lb.) was included in all sprays to control pecan rosette; it also reduced the danger of injury by the lead-arsenate spray. A single well-timed spray had given apparently good results in 1935, when, however, infestation was too light to admit of definite conclusions. In the south-west, single applications, timed by observation of the emergence of adults in the laboratory, were made on 3rd May. On all three varieties of pecan included, nicotine and oil was more effective than lead arsenate. It may have had a greater effect on small larvae that had already entered the nuts.

To determine more accurately the time for applying a single spray, eggs were collected and examined at frequent intervals to ascertain the proportion that had hatched. In one orchard in central Texas, 3 eggs out of a total of 40 found on 16th May and 203 out of 274 found on 5th June had hatched. Single applications of lead arsenate between 14th and 22nd May and a single application of nicotine sulphate and oil on 26th May gave good control, but better and nearly perfect control was obtained with two applications of either spray, the first on 18th May and the second on 30th May or 1st June.

WHITEHEAD (F. E.), WALTON (R. R.) & FENTON (F. A.). **Tests on comparative Effectiveness of Grasshopper Baits.**—*J. econ. Ent.* **30** no. 5 pp. 764-768, 1 fig., 1 ref. Menasha, Wis., October 1937.

Until 1936, the bait recommended for grasshoppers in Oklahoma was the standard one consisting of 100 lb. bran, 2 U.S. gals. molasses,

24 lemons or oranges, 5 lb. Paris green or white arsenic and sufficient water to moisten thoroughly. Changes made from time to time in certain states had lessened cost without impairing control. Accordingly, investigations were made in Oklahoma at the beginning of the 1936 outbreak, the first serious and widespread one in the state for 10 years, on the possibility of improving the formula. Between 1st July and 26th August 1936, 14 modified baits were compared with one made by the standard formula except that 3 oz. amyl acetate was substituted for the 24 *Citrus* fruits. At the time of the tests, the weather was so hot and dry that most of the grasshoppers climbed as high as possible above the ground and sought shade. The predominating species present were *Melanoplus differentialis*, Thos., *M. bivittatus*, Say, and *M. mexicanus*, Sauss., and the majority had reached the adult stage. The baits were spread at the rate of 15 lb. per acre. Estimates of the number of grasshoppers per sq. yd. were made before treatment and on the second or third day after treatment, and counts of dead grasshoppers were also made. Sodium arsenite was used in all the baits instead of white arsenic. The standard mixture gave the best kill, but one from which the molasses and amyl acetate were omitted gave 98·6 per cent. of the control effected by the standard, so that the extra ingredients were not worth the additional expense. A bait composed of 50 lb. bran and 50 lb. sawdust with sodium arsenite and water was 95·7 per cent. as efficient as the standard, and its cost was only 59·4 per cent. as great. The cost for sufficient of this bait to kill the same number of grasshoppers as the standard was lower than that for any of the other mixtures tested except one in which sawdust was substituted for all the bran, which cost less than 1 cent. per acre less. The bait containing half bran and half sawdust appears to be the best of the mixtures and was used extensively in the state in 1936 with satisfactory results. Cotton-seed husks were less successful than many other materials used, but this was probably due to the individual particles being too large. Further tests will be conducted with husks ground approximately to the fineness of wheat bran. The lint adhering to them may cause powdered arsenic to adhere better to the individual particles and also make it possible to use more water in the bait and so keep it moist over a longer period. Rice husks and cane-pulp were not sufficiently promising to justify further trials.

STILES (C. F.), SCHOLL (E. E.) & FENTON (F. A.). **The 1936 Grasshopper Outbreak in Oklahoma.**—*J. econ. Ent.* **30** no. 5 pp. 768–771. Menasha, Wis., October 1937.

The cause of the outbreak of grasshoppers in Oklahoma in 1936 is discussed. A scarcity of Sarcophagid parasites occasioned by exceedingly high soil temperatures may have been partly responsible, as also was the drought that began in 1934 and favoured the development of the grasshoppers. Most of the damage was done by four species, *Melanoplus differentialis*, Thos., *M. mexicanus*, Sauss., *M. bivittatus*, Say, and *Dissosteira longipennis*, Thos. The first three were distributed throughout the whole state, except the extreme north-west and the south-east; *D. longipennis* was largely confined to the north-west, to which it came in the middle of August, flying with the wind from the desert areas. Throughout the infested area, damage was serious only in certain sections of each county. Breeding took place chiefly in lucerne but also in pasture. The greatest economic loss, in descending

order, was caused to cotton, maize and small grains (chiefly oats) ; the total loss exceeded £1,400,000. Grasshoppers, mostly in the hopper stage, were swarming in the pastures, open woodlands and lucerne fields on 23rd May 1936. In June, they began migrating to small grains, cotton and maize. By July, the heat was so great that they began moving to trees along the banks of creeks and stripped them of their foliage, particularly in the south-west. In August, the grasshoppers had practically disappeared from the north-eastern and south-western sections, largely on account of the vegetation drying up through drought. In the north central part, however, many were still present. On 15th September, rain had fallen in some sections and the insects were migrating back to lucerne and wheat, and by early October, oviposition was taking place rather generally ; by 19th November, most of the grasshoppers had died.

The organisation of control with baits [see preceding paper] is described, and the cost is discussed.

MENUSAN jr. (H.). Leafhopper Injury to Potato Foliage and its Relation to Tuber Yields.—*J. econ. Ent.* **30** no. 5 pp. 772-777, 3 figs., 10 refs. Menasha, Wis., October 1937.

The following is based on the author's summary of this account of experiments carried out in western New York in 1934-36. Sulphur dust and Bordeaux mixture (4 : 2 : 50) applied 5 times from late July to early September, at the rate of 60-70 lb. and nearly 200 U.S. gals. per acre, respectively, at each application, to the foliage of potato plants grown in large field cages in which there were no leafhoppers did not significantly increase the number or weight of tubers produced. In cages in which *Empoasca fabae*, Harr., was present in approximately the same abundance as in adjacent potato fields, both treatments reduced the population of leafhoppers and slightly increased the yield. Treated plants in uninfested cages always produced larger yields of tubers than plants receiving the same treatments in infested cages. Injury to foliage caused by leafhoppers was always accompanied by a decrease in the number and size of the tubers produced. A spray of Bordeaux mixture applied to the upper surface only of potato leaves was only slightly toxic to nymphs and did not repel nymphs or ovipositing females, but when the spray was applied to the under surface or both surfaces of the leaves, it was highly toxic and repellent to the nymphs and also repellent to ovipositing females.

McLEAN (H. C.) & WEBER (A. L.). Spray Residue Removal from Cherries.—*J. econ. Ent.* **30** no. 5 pp. 777-779. Menasha, Wis., October 1937.

Late shipments of sour cherries from New Jersey in 1935 were reported to bear more lead residue than the tolerance. A survey in 1936 showed that lead and arsenic in excess of the tolerance occurred on approximately 75 per cent. of the commercial sour cherry crop in the state. In some cases the residue was due to lead arsenate applied to the cherries, in others to spray-drift from adjoining apple orchards. Sour cherries cannot be picked or handled when wet, but the excess residues were successfully removed by placing the cherries in the basket or crate in which they were to be marketed, dipping this for 30-60 seconds into a 1 per cent. solution of hydrochloric acid, agitating

it slowly, allowing the fruit to drain and rinsing twice in the same way in clear water. The washed fruit had a better appearance than unwashed fruit and kept as well. The addition of 0.1 per cent. Vatsol to the acid wash improved the appearance of the cherries.

KNOWLTON (G. F.) & ALLEN (M. W.). **Oblique-banded Leaf Roller, a Dewberry Pest in Utah.**—*J. econ. Ent.* **30** no. 5 pp. 780–785, 1 fig., 1 ref. Menasha, Wis., October 1937.

Moths bred from the Tortricid larvae attacking dewberry fruits in Utah [*R.A.E.*, A **23** 532] were identified as *Tortrix (Cacoecia) rosaceana*, Harr. The damage caused by the larvae has been observed since 1929 and possibly occurred earlier. In 1936, caged adults oviposited from 28th June to 15th July, and the eggs hatched after 8–13 days. In the field, the eggs were deposited on the leaves of dewberry and other plants in masses of 46–279. Larvae hatched from 1st to 20th July, and immediately began to crawl over the leaves and stems of the dewberry plants in search of a suitable place to feed, eventually settling on a leaflet or under the calyx of a green or ripe fruit. Feeding on the drupelets caused these to become shrivelled and discoloured. In severe infestations, as many as 5 young larvae were observed feeding on one berry. On account of the small size of the larvae in late summer, damage to foliage was seldom observed except on close examination. Larvae in fruits usually continued to feed until these became dry, and sometimes remained in the dry berries, but frequently moved to the foliage in the autumn. The larvae passed the winter in hibernacula concealed in loose bark, beneath the bud scales or in the angle of the petiole and stem.

Most of the overwintered larvae had emerged from hibernation by the middle of April in 1936. They tied and folded the new leaflets and flower buds together and fed inside the leaf masses. One larva sometimes tied up and fed on as many as five leaf masses during late May and early June. Spring larvae were collected on black currants and roses as well as dewberries. Pupae were observed from 11th June to 1st July. Pupation took place in the bunch of leaves last fed on by the maturing larva, and the pupal stage, under cage conditions, lasted 9–16 days. Fertile eggs were laid within two days of emergence, and individual females laid 240–900 eggs each. The moths lived for 3–17 days. There was no evidence of a second generation.

Pruning dewberry bushes several weeks before the first buds burst and burning prunings and the litter round the bushes materially lessened injury, and hand-picking and destruction of larvae in infested leaf masses before 15th May reduced subsequent injury to fruit and foliage. *Pimpla (Itoplectis) atroxalis*, Cress., *Glypta simplicipes*, Cress., *Macrocentrus amicropoides*, Vier., *Microdontomerus fumipennis*, Crwf., and the hyperparasite, *Catolaccus aeneoviridis*, Gir., were reared from larvae, and the Tachinid, *Phorocera erecta*, Coq., from pupae.

GAINES (J. C.). **Tests of Insecticides for Cotton Boll Weevil and Bollworm Control using the Latin Square Plat Arrangement and Analysis of Variance.**—*J. econ. Ent.* **30** no. 5 pp. 785–790, 1 fig., 2 refs. Menasha, Wis., October 1937.

The following is based on the author's summary: The Latin square block arrangement [*R.A.E.*, A **25** 428], with blocks of 0.05 acre, was

used in tests of dusts for the control of *Anthonomus grandis*, Boh., and *Heliothis armigera*, Hb. (*obsoleta*, F.) on cotton in Texas in 1936. This method eliminated the variation due to differences of soil and uneven distribution of the insects. The analysis of variance was used to interpret the data. The dusts were applied ten times from 10th July to 22nd August, and all treatments gave significant control. There was no significant difference in the control of *A. grandis* effected by 6.9 oz. calcium arsenate, 14 oz. calcium arsenate and sulphur (1:1), 6.9 oz. calcium arsenate and Paris green (5 per cent.) and 6.6 oz. calcium arsenate and lime (25 per cent.) per block, but when the dosage of calcium arsenate was reduced by 25 per cent. by the addition of lime, the toxicity to *H. armigera* was reduced. The average of the differences in percentage injury by it on plots receiving this treatment and the three others was 3.8, and the average of the reductions in yield per block was 6.9 lb. Aphids increased on all blocks.

McPHAIL (M.). **Relation of Time of Day, Temperature and Evaporation to Attractiveness of Fermenting Sugar Solution to Mexican Fruitfly.**—*J. econ. Ent.* **30** no. 5 pp. 793-799, 2 figs., 1 ref. Menasha, Wis., October 1937.

An account is given of field experiments in southern Mexico on the effect of time of day, temperature and rate of evaporation on the attractiveness of fermenting sugar solution to *Anastrepha ludens*, Lw. The numbers of flies attracted to 10 traps placed in mango trees where they were concentrated for oviposition, the time of day, the average temperature and the rate of evaporation were recorded for each of eight periods of $1\frac{1}{2}$ hours from 7 a.m. to 7 p.m. on three consecutive days. The influence on the numbers of flies caught of the three factors is analysed mathematically. There was a difference in the reaction of the sexes. In the case of males, time and temperature both had a marked effect and evaporation was the least important. The attractiveness of the bait to males due to time decreased during the course of the day, while attractiveness due to temperature or evaporation increased with an increase in temperature or evaporation. The order of importance of the factors in the case of females was temperature, evaporation, time.

SAKIMURA (K.). **On the Bionomics of *Thripoctenus brui* Vuillet, a Parasite of *Thrips tabaci* Lind., in Japan I-II.**—*Kontyû* **11** nos. 5-6 pp. 370-390, 410-424, 7 figs., 55 refs. Tokyo, September-December 1937. (With a Summary in Japanese.)

SAKIMURA (K.). **Introduction of *Thripoctenus brui* Vuillet, Parasite of *Thrips tabaci* Lind., from Japan to Hawaii.**—*J. econ. Ent.* **30** no. 5 pp. 799-802, 1 fig., 3 refs. Menasha, Wis., October 1937.

In the first paper are given a list of the Hymenopterous and Nematode parasites of Thysanoptera, showing their hosts, the countries in which they occur, and the authorities for the records, and an account of studies in Japan on the bionomics of *Thripoctenus brui*, Vuillet, all stages of which are described. This Eulophid occurs round Tokyo and Keijo and in three of the Loochoo Islands. It is an endoparasite of *Thrips tabaci*, Lind., which is its chief host, *T. abdominalis*, Crwf., and *Taeniothrips alliorum*, Priesn.

In the laboratory, the duration of adult life was about 20 days; the ratio of males to females was 2:3 and pairing was observed [cf. *R.A.E.*, A **24** 813]. The combined egg and larval stages together lasted 7–14 days, the pupal stage 13–27 days, and the preoviposition period about 1–2 days. The average life-cycle lasted 23·7 days in summer and 38·8 in autumn.

Oviposition normally takes place in young host larvae, and the parasite breaks its way out of the host to pupate while the latter is in the prepupal stage in soil or débris. Oviposition by the parasite occurs in nature up to a little before the host enters the prepupal stage. In confinement, females also oviposited in prepupae and pupae, but the parasite larvae killed their hosts, either in the pupal or adult stage, before they themselves had developed far enough to pupate. Host pupae only gave rise to adults if the parasite eggs had not already hatched in them. Some pupae were killed by the act of oviposition. In cases in which more than one egg was deposited in a host, only one parasite larva developed normally.

Adults emerge from overwintered pupae in late May. There are five generations a year, but some individuals of the fourth generation hibernate. Parasitised host larvae are found until late October or early November. During the first half of the parasite season, the parasites are not numerous enough to effect a marked reduction in the host population, but during the latter half of the season the host is controlled by the parasite in association with climatic and other mortality factors. In August 1934, parasitism in fields averaged 33·55 per cent.

The second paper is an account of the introduction of *T. brui* into Hawaii for the control of *Thrips tabaci*, which is the vector of the virus of pineapple yellow spot there. Shipments were made from Japan in 1932, 1933 and 1934. As laboratory breeding of the parasite is difficult, supplies were obtained by beating larvae of *T. tabaci* from onion plants in the field on to cardboard, and collecting them by means of sucking tubes. The parasites from these were at first reared to the pupal stage and shipped at low temperature in folded papers inside glass vials, but few adults emerged, and these were very weak. Attempts to transport parasitised larvae on sprouted onion bulbs in ventilated cans were also unsuccessful. In 1933, shipments of host larvae on green onions were made in cages of wood and brass gauze designed by C. T. Schmidt, which are described in detail. The onions were planted in cans and the space between the cans filled to a depth of 2–3 ins. with a fumigated mixture of soil and peat in which the larvae could pupate. From 10,000 to 20,000 host larvae were transferred to each cage. The percentage of parasitism ranged from 6·1 to 67·4. From the shipments made in 1933 and 1934, 27,531 and 16,575 adults of the parasite emerged. Emergence generally took place some days after the insects were received in Hawaii. Two generations were bred in the laboratory, but most of the adults were liberated. As *T. tabaci* was only to be found in low concentration on any one food-plant in the neighbourhood of pineapple fields, the parasites were liberated among onions where it was abundant. In some places, patches of onions were specially planted near fields of pineapple. A description is given of a special cage designed by W. Carter for the conveyance of adult parasites with hosts on onion plants from one island to another. It was so devised that the plants could be lifted out without disturbing the soil and roots.

BARBER (G. W.). **Preference of Corn Earworm Moths for Sweet Corn for Oviposition.**—*J. econ. Ent.* **30** no. 5 pp. 802–803, 1 fig. Menasha, Wis., October 1937.

Observations in Virginia in 1925, 1926 and 1927 established the fact that sweet maize received many more eggs of *Heliothis armigera*, Hb. (*obsoleta*, F.) than field maize. Eggs were laid on sweet maize and field maize at the average rates of 1.5 and 0.4 per plant per day, respectively. While the abundance of eggs varied with the year and season, the preference for sweet maize was always observed, though it was greater in June and July than in August and September.

DAHMS (R. G.). **Number of short-winged Chinch Bugs produced under Laboratory Conditions.**—*J. econ. Ent.* **30** no. 5 pp. 803–804. Menasha, Wis., October 1937.

Of adults of *Blissus leucopterus*, Say, reared in Oklahoma on different varieties of *Sorghum* and maize, from nymphs hatched from eggs laid by long-winged females feeding on barley in the laboratory, over 40 per cent. were short-winged in both 1935 and 1936. There was no indication of any relation between the numbers of short-winged forms and the resistance of the food-plants. Ordinarily, in south-western Oklahoma, considerably less than 1 per cent. of the bugs are short-winged.

CHAMBERLIN (F. S.) & MADDEN (A. H.). **Vegetable Weevil, *Listroderes obliquus* Klug, feeding upon Tobacco.**—*J. econ. Ent.* **30** no. 5 pp. 804–805, 1 ref. Menasha, Wis., October 1937.

The vegetable weevil, of which the authors consider the correct name to be *Listroderes obliquus*, Klug [cf. *R.A.E.*, A **25** 291], was observed feeding upon the tender outer leaves and buds of young tobacco in beds in Florida in late March 1937. During early April, the infestation increased and the larvae caused considerable loss of plants in the portion of the bed attacked. They were also observed feeding on plants in two fields of newly planted tobacco, and attacked plants were severely injured, although the infestation was small in extent. This is the first record of this weevil attacking tobacco in the United States.

VENABLES (E. P.). **The Fruit Tree Leaf Roller, *Cacoecia argyrospila* Walk., and its Control in British Colombia.**—*Publ. Dep. Agric. Canada*. no. 576 (Circ. 124; rev. Circ. 10), 4 pp., 4 figs. Ottawa, June 1937.

This is a revision of a circular already noticed [*R.A.E.*, A **15** 46]. The strength of the lead arsenate spray recommended against *Tortrix* (*Cacoecia*) *argyrospila*, Wlk., on fruit trees is reduced to 3 lb. in 80 gals. water.

BURNHAM (J. C.). **Discovery of an Autumn Host Plant of *Myzus persicae* Sulzer.**—*Canad. Ent.* **69** no. 9 p. 208. Orillia, Ont., September 1937.

For the past three years there has been an annual increase in the numbers of *Myzus persicae*, Sulz., on potato in one part of New Brunswick. The Aphids leave the potatoes in September, but the winter

food-plants were not discovered until 1937, when, between 8th and 11th September, the winged autumn migrants were found feeding and reproducing on the foliage of *Prunus pennsylvanica* and *P. virginiana*.

LEWIS (H. F.). **Outbreak of Armyworms** (*Cirphis unipuncta* Haw.) in Saguenay County, Quebec.—*Canad. Ent.* **69** no. 10 pp. 231–233. Orillia, Ont., October 1937.

Notes are given on an outbreak of the armyworm, *Cirphis unipuncta*, Haw., in August 1937 on a strip of the Quebec shore of the Gulf of St. Lawrence about 190 miles long. Most of this area is uncultivated, and the larvae fed chiefly on grasses, but they caused severe damage to oats and buckwheat over the few acres where these crops were growing. Numbers of them were eaten by various small birds.

Java Beetle for Control of Banana Borer.—*J. Jamaica agric. Soc.* **41** no. 9 p. 503. Kingston, September 1937.

Arrangements have been made for 9 consignments of the predacious Histerid, *Plaesius javanus*, Er., to be introduced from Fiji into Jamaica for the control of the banana weevil [*Cosmopolites sordidus*, Germ.]. The first shipment arrived on 14th August 1937, and the insects were released in a specially prepared observation plot.

EDWARDS (W. H.). **Horn-worms which defoliate Sweet Potato Vines.**—*J. Jamaica agric. Soc.* **41** no. 9 p. 515. Kingston, September 1937.

Many fields of sweet potato in Jamaica have recently been completely defoliated by larvae of *Herse cingulata*, F. Large numbers usually hatch at one time, and, as the food-supply becomes exhausted, they gradually move to fresh crops. Outbreaks in restricted areas may be partly controlled by hand-picking the larvae in the cooler part of the day; at midday they shelter in cracks in the soil or under plant refuse. Cryolite, sodium fluosilicate and other stomach poisons as sprays or dusts give good control. Applications should be made not only on infested plants but also on those that will form a barrier to the migrating larvae.

MENDES (L. O. T.). **Ocorrência de *Gnorimoschema operculella* (Zeller) em tubérculos de batatinha, em campos de cultura do Estado de São Paulo.** [The Occurrence of *Phthorimaea operculella* in Potato Tubers in Fields in the State of São Paulo.]—*Bol. tec. Inst. agron. Estado S. Paulo* no. 35, 5 pp., 1 pl., 8 refs. Campinas, 1937.

The first record of *Phthorimaea* (*Gnorimoschema*) *operculella*, Zell., in Brazil was from tobacco in 1934 [*R.A.E.*, A **13** 21]. It is here recorded from potato tubers in two distinct localities in São Paulo.

ARAÚJO (R. L.). **As brocas de casuarina.** [Pests of *Casuarina*.]—*Biologico* **3** no. 10 pp. 310–311. S. Paulo, October 1937.

The insects that bore in *Casuarina* in Brazil include the Cryptophasid, *Timocratica albella*, Zell., and the twig-cutting Lamiid, *Oncideres dejeani*, Thom., but the most injurious is *Pantophthalmus pictus*, Wied. The adults of this fly oviposit on the bark in summer, and the larvae,

which hatch in about 24 days, bore horizontally into the wood, causing a flow of sap. The life-cycle takes about 2 years. Various trees other than *Casuarina* are also infested, but *C. suberosa* appears to be immune and *C. stricta* is only slightly attacked.

Memoria de la Comisión Central de Investigaciones sobre la Langosta correspondiente al año 1935.—127 pp., 10 figs., 10 pls., 19 graphs, 5 maps, 99 refs. Buenos Aires, Minist. Agric. Argent., 1937.

This is a third report on investigations on *Schistocerca paranensis*, Burm., carried out under the auspices of the Central Commission of Locust Investigations in Argentina [*cf.* R.A.E., A 23 73; 25 114].

In Informe de la comisión investigadora del oeste (pp. 13-69, 11 figs., 19 graphs, 4 pls.), P. Köhler gives an account of studies on the pigments and on the biology of *S. paranensis*, the latter carried out under semi-natural conditions at San José, Salta Province. It was found that the red pigment, which in autumn and winter fills the empty spaces in the chitin of the adult locusts, is probably a melanin produced by oxidation of tyrosinases, which is transformed into black melanin by repeated oxidation. The red colouration persists in winter, owing to this process being arrested by low temperature. The black pigment, which is precipitated in the chitin in a definite pattern, and the quality and quantity of which depend on the metabolic activity of the locust, is therefore merely the final excretory product of oxidation [*cf.* 20 672]. A study of colour variations in hoppers, which are entirely dependent on the degree of oxidation according to environmental conditions, suggests that phases do not exist in this species.

The aggregation of *S. paranensis* is thought to be due to thermotropism, the adults being mutually attracted, in winter, by thermic rays emitted by the red melanin. The directions of migrations in hoppers are determined by thermotropism, and the route followed by a band is a curve, for the moving hoppers always directly face the sun. *S. paranensis* normally has one generation a year, with a winter diapause in the adult stage, but in northern Argentina some of the locusts mature soon after becoming adult, probably owing to abnormal ecological conditions.

In Informe de la comisión investigadora del este (pp. 73-104, 3 maps, 3 pls.), by J. B. Daguerre, the dispersion and southward spring migration of swarms of *S. paranensis*, which hibernate in northern Argentina, and the northward return of their progeny, are described and illustrated by maps. The migrations appear to depend on meteorological conditions, and no flights occur at temperatures below 20°C. [68°F.]. The southward migrating swarms are dense, fly high, are assisted by the upper winds, and follow regular routes every year. The actual course of spring migration in 1935 is described; most of the swarms proceeded southwards into the Provinces of Córdoba, Santa Fé, Entre Ríos and Buenos Aires, where they oviposited in September, but some diverged to the south-east and penetrated into Brazil. During the return northward migration of the new generation, which begins in late December and continues till early April, the locusts fly in very loose swarms, about 300 ft. above the ground; after this migration they become concentrated in the western Chaco.

It is suggested that Dipterous parasites and fungous diseases are the chief factors inducing the migratory behaviour. Successful

breeding in the north is prevented by infestation by *Sarcophaga caridei*, Brèthes, as well as by excessive heat; the swarms migrating southwards fly to zones free from the flies and with conditions of humidity and temperature favourable for breeding. It is concluded that there are no phases in this species, in which existence in a solitary state is transitory and accidental. Solitary adults were widespread between October and December 1935, but they concentrated into swarms at the approach of migrations. With these solitary adults of *S. paranensis*, however, there also occurred adults and hoppers of a truly solitary species, probably *S. cancellata*, Serv.; both kinds of solitary adults are described.

In Observaciones de carácter botánico (pp. 104-106), T. Meyer describes the different types of hydrophilous forest vegetation of the Chaco region. *S. paranensis* prefers tall open forest and xerophilous forests and thickets, but only the riverine meadows, overgrown by tall *Panicum prionitis*, are completely free from it. Dispersed locusts live mainly in savannas on high ground among espartillo grass (*Elionurus adustus*), which covers enormous areas in the Chaco. It is, however, not touched by the locusts, which feed on tender Compositae and Leguminosae, as well as on *Cynodon dactylon*, *Chenopodium ambrosioides* and species of *Chloris*, *Andropogon* and *Eragrostis*. Caged locusts prefer cultivated plants (lettuce, chicory, maize and cabbage), while in swarms they devour potato plants.

In Informe acerca de los trabajos realizados en el insectario de José C. Paz (pp. 107-126, 3 pls.), J. Liebermann gives an account of laboratory investigations on locust biology carried out since 1935. Preliminary experiments have shown that a humidity of 50-70 per cent. and a temperature of 25-35°C. [77-95°F.] are necessary for normal development; caged adults kept from June to November at 30°C. [86°F.] failed to reach sexual maturity, probably owing to excessive activity caused by high temperature. Eggs laid in open-air cages hatched in about 50 days, in mid-December.

An Anthomyiid, *Phorbia* (*Hylemyia*) *cilicrura*, Rond., emerged from eggs of *S. paranensis* sent from Santa Fé. Some eggs were infected by the Phycomyce, *Cunninghamella* sp., which caused their desiccation; experiments on artificial infection of eggs with this fungus were successful. Attempts to infect locusts with *Empusa grylli* produced wholly negative results. Many adults collected at José C. Paz in November 1935 were infested by the mite, *Podapolipus berlesei*, Lah.; they also showed symptoms of infection by *Coccobacillus*, suggesting that there may be a connection between the mites and the disease.

HUSSEIN (M.). **The Effect of Temperature on Locust Activity.**—*Bull. Minist. Agric. Egypt* no. 184, 55 pp., 3 figs., 22 graphs, 15 refs. Cairo, 1937. Price P.T. 10.

This is an account of investigations carried out in 1936 in London, the material for which consisted of laboratory bred examples of *Locusta migratoria migratorioides*, R. & F., *Schistocerca gregaria*, Forsk., and *Nomadacris septemfasciata*, Serv. The technique of the experiments and the apparatus used for gradual heating and cooling of the locusts are described, and tables and graphs illustrate in great detail the temperature limits for different stages of activity in different instars and species. The author defines 11 such stages, ranging from 0 or cold stupor to 10 or heat stupor, with stage 5 representing normal

activity. When the temperature was being reduced, the stages below normal activity for any given instar were observed at lower temperatures than those at which they occurred when the temperature was being increased to normal after the insects had been submitted to 32–34°F. for varying lengths of time, this difference varying directly with the duration of exposure to cold. In cooling experiments, the temperatures at which given activity stages terminated in different instars became progressively lower with the increase in size of the insect. In heating above the normal range of activity, the temperature limits for different stages were lower in smaller hoppers than in larger ones. This proves that the behaviour of hoppers is governed by the temperature of the environment acting through their body temperatures, and that its effect on the latter is influenced by the size of the body. This is further confirmed by the fact that on being warmed after exposure to 32–34°F. for 1–1½ hours, large hoppers and adults displayed given activity stages at lower temperatures than small hoppers, but when they were warmed after exposure for 12–15 or 45–48 hours, during which the temperature of locusts of all sizes was reduced to that of the environment, the small hoppers became active before the larger ones.

Just after the moult, the locusts reacted more quickly to changes of temperature than later on in the stage. Sexually mature adults were more sensitive than immature ones to temperature changes when heated and cooled above or below the normal, but after a short exposure to cold their temperature limits for different activity stages became higher. Normal activity covered the widest range of temperature (73–99°F.) in adults of *Locusta*; in *Schistocerca* the corresponding figures were 75–99°. It is suggested that, in the field, mass movement of hoppers and strong flights of adults are expressions of abnormal activity induced by high temperature.

The temperature limits for different activity stages were slightly higher in *Schistocerca* than in *Locusta*, while in *Nomadacris*, which was the least active and the most sensitive to cold, the limits were considerably higher. On being warmed after exposure to cold, the stupor in general terminated first in *Locusta* (at 36–46°F. for the fifth instar after exposure for 1–1½ hours to 32–34°), then in *Schistocerca* (at 37–50°) and last in *Nomadacris* (40–49°).

In conclusion, the results of similar investigations are summarised from the literature [cf. *R.A.E.*, A 17 632; 18 184, 623] and compared with those obtained by the author.

ANANDA RAU (S.). **Report of the Entomologist.**—*Rep. Tea Dep. U.P.A.S.I. 1936–37* pp. 14–24. Madras, 1937.

In experiments against *Helopeltis* infesting tea in south Travancore [cf. *R.A.E.*, A 24 39], 1 or 3 applications in April–July of a spray of 2 per cent. resin fish-oil soap, which gave promising results in the laboratory, effected only temporary control, sprayed plots being as heavily infested at the end of August as untreated ones. Spraying small areas is useless, and the cost for large ones prohibitive. The shot-hole borer, *Xyleborus fornicatus*, Eichh., was observed in tea in several estates in the Vandiperiyar district [cf. 25 65], in which it appears to have occurred for over 10 years, and in one field injured 15–20 per cent. of the bushes. It is important to control it while it is still localised; recommended measures include removing and

burning infested branches, precautions to avoid the transport and introduction of infested material, and manuring to stimulate good growth in bushes. The borer was also found to attack *Crotalaria* on one estate, but no plant other than tea was so infested as to constitute a source of danger.

Damage to living tea bushes in the Anamallais by species of *Coptotermes* and *Calotermes* [25 65] continued, and *Coptotermes* sp. was reported in dry and green wood of tea in Mundakayam. The elimination of all dead wood, through which the termites gain entrance to living bushes, and the prevention of wood-rot are recommended. Other pests observed on tea included *Zeuzera coffeae*, Nietn., which was still confined to isolated bushes in the Anamallais and central Travancore, *Eterusia* (*Heterusia*) *virescens*, Btlr., which is largely controlled by Tachinids, including a species of *Sturmia*, *Boarmia* (*Ectropis*) *bhurmitra*, Wlk., which occurred in January and then disappeared, probably owing to the energetic hand-collection of pupae, *Stauropus alternus*, Wlk., *Saissetia coffeae*, Wlk., and *Tenuipalpus obovatus*, Donn.

Among pests of shade-trees, females of a Lamiid, probably *Sthenias grisator*, F., were observed girdling the branches of dadap [*Erythrina*] below points where they had oviposited, thus causing die-back and, in extreme cases, breaking of the branches. Larvae developed in the fallen branches, and 8-10 adults emerged from a branch. Cutting and burning infested wood is the only method of control at present available. Other pests of *Erythrina* were the Pyralid, *Terastia meticulosalis*, Gn., which caused die-back of cuttings, and *Mylocerus viridanus*, F., of which the larvae injure the roots, the adults feeding on a wide range of plants. Red gum [*Eucalyptus rostrata*] was severely attacked by *Helopeltis antonii*, Sign., and, on a few estates, by termites.

Parasites of insects infesting tea identified during the year included *Angitia* (*Diocetes*) sp. and *Tetrastichus* sp. from *Gracilaria theivora*, Wlsm., *Opius* sp., *Trigonogastra* sp. and *Closterocerus insignis*, Wtstn., from *Oscinis theae*, Big., and *Brachymeria* sp. from *Homona coffearia*, Nietn.

VEJABHONGSE (N. P.). **A Note on the Habits of a May-fly and the Damage caused by its Nymphs.**—*J. Siam Soc. nat. Hist.* Suppl. 11 no. 1 pp. 53-56, 2 pls., 1 ref. Bangkok, November 1937.

This paper includes records of injury to structural timber under water in Siam by the nymphs of two species of Ephemeroptera.

JARVIS (H.). **Codling Moth Control Experiments, 1936-37.**—*Qd agric. J.* 48 pt. 3 pp. 252-257, 2 refs. Brisbane, 1st September 1937.

In further experiments with substitutes for lead arsenate in cover sprays against the codling moth [*Cydia pomonella*, L.] on apple in Queensland [cf. *R.A.E.*, A 23 267], bentonite-sulphur, colloidal sulphur, thiophenylamine and lead arsenate were used at the rate of 2½ lb., nicotine sulphate at 1 pint, white oil at 1 gal., lime-sulphur at 1½ gals., and potash soft soap at 10 lb., per 80 gals. water. A spreader was added to all sprays except those containing oil or soap. A lead arsenate calyx spray was applied to all trees other than the controls and was followed by 5 cover sprays. The percentages of unattacked fruit were 98.4, 94.4, 93.8 and 73.2 for nicotine sulphate with white

oil, colloidal sulphur, bentonite sulphur and lime-sulphur, respectively, 67.7 for lime-sulphur alone, 76.7 for thiodiphenylamine, 98.0 for potash soft soap alone, 97.0 for potash soft soap with colloidal sulphur, 84.2 for lead arsenate and 46.2 for the controls. The fruit on all trees treated with sprays in which a spreader was used showed surface spotting, which was particularly severe in the case of thiodiphenylamine and lead arsenate. Cover sprays of these two materials resulted in leaf scorch.

The weather at the blossoming period was unusually cold, and the moths of the overwintered brood emerged later and in smaller numbers than usual. Calyx infestation was accordingly low, and of 1,070 infested apples, 79.9 per cent. had been entered from the side.

The costs of spraying are discussed, and an analysis of the potash soft soap is given.

LAING (J.). **Host-finding by Insect Parasites. 1. Observations on the finding of Hosts by *Alysia manducator*, *Mormoniella vitripennis* and *Trichogramma evanescens*.—*J. anim. Ecol.* 6 no. 2 pp. 298–317, 5 figs., 18 refs. Cambridge, November 1937.**

The following is the author's summary: The problem of host-finding is stated and analysed. It is shown by experiments that the parasites *Alysia manducator*, Panz., and *Mormoniella vitripennis*, Wlk., are attracted to an environment likely to contain their hosts by qualities of the environment itself, independent of the presence of hosts. Evidence is adduced that several other parasites are likewise first attracted to a special type of situation in which they then seek their hosts.

Within a host-containing area, the parasite *Trichogramma evanescens*, Westw., is able to perceive its hosts (eggs of *Sitotroga* [*cerealella*, Ol.]) by the sense of sight. It does not appear to be able to perceive them at a distance by the sense of smell, but it is attracted to traces left by *Sitotroga* females. *Trichogramma* normally moves about in straight or widely curving lines with only occasional abrupt turns. On such a path, it finds its first host. When it leaves that host, however, or any host which it has parasitised or examined, it moves quite differently, taking a spiral, twisted path. This change of behaviour greatly increases the frequency of contact between the parasite and its hosts.

SOLOMON (M. E.). **Behaviour of the Red-legged Earth Mite, *Halotydeus destructor*, in Relation to environmental Conditions.**—*J. anim. Ecol.* 6 no. 2 pp. 340–361, 10 figs., 7 refs. Cambridge, November 1937.

The following is based on the author's summary of investigations carried out in Western Australia: The reactions of *Halotydeus destructor*, Tucker, to the physical and chemical stimuli to which it is exposed were observed and tested experimentally, together with the effect of these stimuli on special activities, such as food-plant selection and oviposition. The mite is positively phototropic, except when in very bright light, such as strong sunlight; if no bright source of light is visible, it selects a subdued light, avoiding bright light and darkness. It avoids extremes of temperature, but between these limits its selective activity is not marked; the higher the temperature, the greater is the mite's activity. It has no strongly developed selective behaviour in relation to atmospheric humidity; but it generally selects a moist soil and

usually avoids free water. Its palps and forelegs serve as tactile organs; it was indifferent to the feel of some surfaces, such as dry sand and paper, and was repelled by that of others, such as vaseline and paraffin wax. Under favourable physical conditions, it is stereotropic and is made restless by vibration. Food-plant selection is the result of random wandering with repeated testing of the substratum by means of tactile and gustatory organs. Web-spinning is probably a male characteristic and depends to some extent on the presence of moisture. In the selection of sites for oviposition (the undersides of leaves of *Cryptostemma calendulaceum* are preferred), it was observed that edibility of leaves was not a factor influencing the choice; texture, moisture and position are important factors, and temperatures above about 28°C. [82.4°F.] put a stop to all further oviposition. In general, the activity of the mites under certain favourable conditions is subdued and conditions departing from the optimum range call forth the more vigorous activity of running.

BELL (A. F.). [Report of the] Division of Entomology and Pathology.—*Rep. Bur. Sug. Exp. Stas Qd* 37 pp. 34–37. Brisbane, 1937.

In the year ending June 1937, the degree of infestation of sugar-cane by *Lepidoderma albohirtum*, Waterh., varied considerably in different parts of northern and central Queensland, depending on the amount of rain during and after the flight period [*R.A.E.*, A 24 273; 25 314]. Where outbreaks are sporadic, fumigation is uneconomic, and experiments have therefore been carried out on the resistance of stronger rooting canes. Of these P.O.J. 2725 is the most satisfactory, as it is also resistant to downy mildew and top rot. Flame-throwers were used against the adult beetles on the trees on which they feed, but owing to their limited range, were ineffective except on low foliage. Sprays of 4, 6 or 8 lb. lead arsenate in 100 gals. water, with linseed oil as an adhesive, gave good results, and analyses of sprayed foliage 4½ months after treatment showed that a large amount of lead arsenate still adhered to the leaves. A parasite recently reared from an adult of *L. albohirtum* has been identified as *Sturmia elzneri*, Tns.

Rhabdocnemis obscura, Boisd., was less abundant on sugar-cane than in 1936, but caused serious losses. Investigations on it [25 739, 740] are briefly reviewed. Weather conditions in 1937 in the Mackay district were very favourable to the survival of the early instars of *Lacon variabilis*, Cand., and where drainage is inadequate, extensive damage is to be expected. *Sturmia inconspicuoides*, Baranov, and an undescribed Tachinid were reared from *Laphygma (Spodoptera) exempta*, Wlk. The former is the more important, and it also attacks other Noctuids infesting sugar-cane.

MEYRICK (E.). *Exotic Microlepidoptera*, 5 pt. 5 pp. 129–160. Marlborough, Wilts., the author, November 1937. Price 3s. per part.

The new species described include *Odites microbolista* and *Eucosma phylloscia*, both on coffee in Uganda, the first bred from a leaf-rolling larva and the second from larvae feeding in the berries.

SMIT (B.). *The Insect Pests of Lucerne in South Africa*.—*Bull. Dep. Agric. For. S. Afr.* no. 170 pp. 84–88. Pretoria, 1936. Price 6d. [Recd. December 1937.]

Lucerne in South Africa is attacked by a number of insect pests that occur sporadically. The most important is the Pierid, *Colias electo*, L.,

which lays eggs singly on the young leaves. The larvae hatch in 4–11 days, feed on the terminal leaves and pupate on the plant. The larval and pupal stages last 20–25 and 7–11 days, respectively, in summer and 38–70 and 17 days in winter. There are usually 7 generations a year. The larvae are often attacked by a bacterial wilt, which destroys them in great numbers and appears to be associated with the presence of moisture, being prevalent in irrigated lands. Larvae fed experimentally on water-soaked leaves of lettuce developed the disease in a few days. The same effect may be produced in the field by harrowing or grazing sheep on infested lucerne, the crushed stalks and larvae providing the necessary conditions of humidity.

The polyphagous larvae of *Heliothis armigera*, Hb. (*obsoleta*, F.) sometimes attack lucerne, and are particularly injurious if they migrate to it when it is sprouting. When they occur on the crop, premature harvesting is often the only method of control, but when they are on weeds near it they may be destroyed by sprays of sodium arsenite (1 oz. in 4 gals. water). Their migration can be prevented by ditches filled with water, or by poison baits. Other pests include the larvae of *Laphygma exigua*, Hb., which migrate and may be controlled in the same way as *H. armigera*; *Zonocerus elegans*, Thnb., the newly-hatched nymphs of which occur in swarms and may then be destroyed by a spray of sodium arsenite; the lucerne seed Chalcid [*Bruchophagus gibbus*, Boh.], which sometimes infests all lucerne seed in the Karroo; and a leafhopper that causes yellowing of the plants but may often be controlled by flooding the fields. The Aphid, *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.) occasionally occurs on lucerne, but its numbers are kept down by natural enemies.

S[TANSFIELD] (F. W.). **Another Fern Pest.**—*Brit. Fern Gaz.* **6** no. 9 pp. 237–238. Reading, December 1933. [Recd. January 1938.]

The sawfly, *Heptamelus ochroleucus*, Hal., is recorded as attacking ferns in Britain in 1933. It caused serious damage to *Athyrium* spp., and also infested *Blechnum* and *Polypodium vulgare*. It probably has only one generation a year; the larvae bore in the stalks of the ferns in spring, but apparently leave the stalks before pupating.

PETCH (T.). *Isaria exoleta* Fr.—*Naturalist* no. 958 pp. 250–251. London, November 1936. [Recd. December 1937.]

Isaria exoleta, Fr., was described from specimens on pupae of *Calocampa* (*Noctua*) *exoleta*, L., in Germany. The author has observed the same fungus on a Lepidopterous pupa from Yorkshire and concludes that it belongs to the genus *Hirsutiella* and that *Cordyceps fuliginosa*, Ces., from pupae of *Orgyia* (*Bombyx*) *antiqua*, L., in Italy is a synonym of it.

PETCH (T.). *Cordyceps militaris* and *Isaria farinosa*.—*Trans. Brit. mycol. Soc.* **20** pt. 3–4 pp. 216–224. Cambridge, November 1936. [Recd. December 1937.]

The author concludes that the conidial stage of *Cordyceps militaris* is a *Cephalosporium*, and that *Isaria farinosa*, no perithecial stage of which is known, has no relation to it. *C. militaris* attacks the larvae and pupae of Lepidoptera (two records on cockchafers are probably erroneous), while *I. farinosa* occurs on Lepidoptera, Hymenoptera, Coleoptera, Diptera, Aphids and Arachnida.

PETCH (T.). **Notes on entomogenous Fungi.**—*Trans. Brit. mycol. Soc.* **21** pt. 1-2 pp. 34-67. Cambridge, October 1937.

This paper deals with some 40 species of entomogenous fungi. It includes notes on their characters, distribution and synonymy, and descriptions of 18 new species.

CANZANELLI (A.). **II *Dermestes lardarius* L.**—*Boll. Sez. ent. Oss. fitopat. Milano* **6** (1934-35) pp. 19-65, 2 pls., 1 diagr., 70 refs. Milan [? 1937].

In Italy, *Dermestes lardarius*, L., is a pest in connection with the rearing of silkworms [*Bombyx mori*, L.], feeding on the eggs, pupae and dead adults of the moth and ovipositing in its cocoons. A detailed account is here given of its biology, including embryology, and the morphology of all stages, the author's observations being compared with those recorded in the literature.

The larvae first appear towards the end of May. In the laboratory, they preferred half decomposed pupae, dead adults and eggs of the silkworm to dry bread, biscuit or maize flour, and individuals that fed on the latter did not pupate. They could not penetrate healthy cocoons or even attack the silken envelope of such cocoons, either dying of hunger or devouring each other instead. The larval stage lasted about 2 months in May-July and about 40 days in July-September; all the larvae underwent 6 moults. They were very active, travelling rapidly on any surface, and when full-fed wandered about in search of soft wood in which they excavated tunnels for pupation. Many larvae died without pupating or even succeeding in excavating the tunnel. The pupae were first observed in the second half of August and occurred throughout September. The pupal period normally lasted 10-15 days, but a few of the pupae hibernated. After emergence, the adults usually remained in the tunnels until spring, but those that came out fed moderately if attractive food was offered. The adults never attacked each other, but they ate their dead companions in preference to other food. Pairing and oviposition began in the second half of May, and the eggs hatched in $3\frac{1}{2}$ days at 24°C . [$75\cdot2^{\circ}\text{F}$.]. The oviposition period lasted 2 months, about 200 eggs being laid in batches of not more than five. The sexes were equal in numbers. The adults lived for about 12 months, and there was one generation a year. They flew in spring and summer, but not in winter. The various foods recorded in the literature are noted, and details are given of the injury done in Italy to silkworm cocoons.

Silkworm pupae that had been soaked in hot water and from which the silk had been unwound were highly attractive to *D. lardarius*, and the author has obtained excellent control by making a poison bait of them with the admixture of 20 per cent. of very finely powdered barium fluosilicate; this bait remains efficient for several months. Other Dermestids killed by it were *D. frischeri*, Kug., *D. vulpinus*, F., and *D. aurichalceus*, Kuster.

FAGGIOLI (D.). **Appunti entomologici. IV.** [Entomological Notes. IV.]—*Boll. Ist. Ent. Bologna* **9** pp. 184-195, 3 figs. Bologna, 1937.

These notes include records of parasites bred in Italy from a number of insects, some of which are of economic importance.

GRANDI (G.). **Parassiti della *Cydia molesta* Busck riscontrati nell'Emilia.** [Parasites of *C. molesta* found in Emilia.]—*Boll. Ist. Ent. Bologna* **9** pp: 250–252. Bologna, 1937.

The indigenous parasites that have been reared from *Cydia molesta*, Busck, in Emilia comprise a Braconid of the genus *Microgaster*, and the Ichneumonids, *Hemiteles tricoloripes*, Schmied., *H. areator*, Panz., a species of *Ephialtes* allied to *E. extensor*, Taschbg., *Glypta* (?) *pedata*, Desvignes, *Phylodietus crassitarsis*, Thoms., *Pimpla alternans*, Grav., *P. sagax*, Htg., *Angitia armillata*, Grav., *Nemeritis* sp., *Pristomerus vulnerator*, Panz., *Trichomma enecator*, Rossi, *Bassus lactatorius*, F., and two species of *Phaeogenes*. In addition, three species, *Glypta rufiscutellaris*, Cress., *Macrocentrus ancyliivorus*, Rohw., and *M. delicatus*, Cress., have been imported from the United States.

STELLWAAG (F.) & GÖTZ (B.). **Das Ködern der Traubenwicklerrmotten als Bekämpfungsmassnahme.** [The Trapping of Vine-moths with Baits as a Method of Control.]—*Anz. Schädlingssk.* **13** no. 11 pp. 129–133, 3 diagr., 10 refs. Berlin, November 1937.

An account is given of experiments in which over 140 different substances, chiefly volatile, were tested in baits for the vine-moths, *Clysia ambiguella*, Hb., and *Polychrosis botrana*, Schiff., in Germany. Of those that were not ineffective, none gave consistent results or caught enough moths to offer promise as a method of control. The baits did not seem to be more attractive to one species or sex than to the other, and many of the females taken had already oviposited.

SCHIMITSCHEK (E.). **Verhandlungen über Forstentomologie beim II. internationalen Forstkongress in Budapest 1936.** [Transactions on Forest Entomology at the Second International Forestry Congress in Budapest in 1936.]—*Anz. Schädlingssk.* **13** no. 11 pp. 134–138. Berlin, November 1937.

The papers here summarised include one by M. Nunberg on *Melolontha hippocastani*, F., and *M. melolontha*, L. (*vulgaris*, F.) in forests in Poland. He stressed the need for collection in autumn and early spring of the larvae and adults in the ground, rather than for observations during the flight period, to provide reliable data as a basis for control. By this method the presence and chief flight years of the beetles in different regions of Poland have been ascertained. The life-cycle of *M. hippocastani* lasts five years in northern Poland and four in other parts of the country [cf. *R.A.E.*, A **24** 676; **25** 762]. H. Eidmann discussed the nun moth [*Lymantria monacha*, L.] as a major pest of spruce in East Prussia [**24** 750]. E. Schimitschek himself dealt with the prediction, analysis and prevention of insect outbreaks, emphasising the need for expert study of all outbreaks in the field and for the establishment of permanent stations in forests, including virgin forests.

MÜHLOW (J.). **Några ord om vetemyggan och dess bekämpande.** [A few Words on the Wheat Gall-midge and its Control.]—*EntBlad. pop. Bil. ent. Tidskr.* **1** no. 3–4 pp. 36–38. Stockholm, December 1937.

This paper comprises a short account of the life-history of *Contarinia tritici*, Kby., on wheat in Sweden [*R.A.E.*, A **23** 625] and notes on its

Hymenopterous parasites. The most important of these in Sweden are the Scelionids, *Leptacis tipulae*, Kby., and *Isostasius punctiger*, Nees, which are briefly described. Both species have one generation a year and overwinter in the egg-stage in the larvae of the host.

TRÄGÅRDH (I.). **Husets fiende numro ett.** [Enemy Number One of Houses.]—*EntBlad. pop. Bil. ent. Tidskr.* **1** no. 3-4 pp. 56-62. Stockholm, December 1937.

A popular account is given of the bionomics of the Cerambycid [*Hylotrupes bajulus*, L.] in timber in buildings in Sweden [cf. *R.A.E.*, A **23** 684], where it has been recorded as far north as the central region. The egg, larva and adult are briefly described. A female deposits 40-120 (rarely 300) eggs singly or in small batches mostly in cracks in timber. The duration of development is greatly affected by temperature; the eggs hatch in 1-3 weeks, and the larval stage has been observed to last for from 4 to 11 years, averaging 6 years. The larvae prefer the soft sapwood of conifers, being usually unable to penetrate the harder heartwood [cf. **26** 91]; oak is not attacked. The importance of this in the infestation of buildings is emphasised, poor quality timber being most severely infested. Of the possible ways in which infestation is spread, the commonest is thought to be adult flight, which occurs on warm days from the end of June to the beginning of August. The use of metal gauze over open windows in attics, etc., would hinder this. The usual control measures are fumigation with hydrocyanic acid gas and treatment with hot air [cf. **21** 214].

HAMMER (M.). **Kløversækmøllet** (*Coleophora spissicornis* Hw.). [The Clover Case-bearer.]—*Tidsskr. Planteavl* **42** pp. 333-343, 5 figs., 13 refs. Copenhagen, 1937. (With a Summary in English.)

During the last few years, *Coleophora spissicornis*, Haw., has been observed as a pest of red clover [*Trifolium pratense*] grown for seed in Denmark, where it had previously been recorded on *T. arvense*. Notes are given on the world distribution of this Tineid, and the egg, larva and adult are described. The moths occur from mid-June to mid-July and lay their eggs singly or in pairs in the inflorescences. The larvae spin the florets together to form a case and feed on the ovules. They overwinter in their cases on the ground, resume feeding in spring, and pupate in May. In one district in 1935, 85 larvae were observed in 190 heads of clover, and 16 per cent. of inflorescences were destroyed. Laboratory experiments showed that a larva destroys 2-3 florets per day and that *Trifolium repens* may also be attacked.

Manuel des matières auxiliaires de l'agriculture publié par les établissements fédéraux d'essais et d'analyses agricoles, avec l'approbation du département fédéral de l'économie publique (du 20 janvier 1937).—*Landw. Jb. Schweiz* **51** Heft 9 pp. 961-1030. Bern, 1937.

This manual makes known the standards adopted by the Swiss Federal Agricultural Experiment and Analytical Stations in appraising commercial preparations for use in agriculture and recommended for adoption as conditions of sale of such preparations. It includes a chapter (pp. 1003-1022) on products for the protection of cultivated

plants, comprising a first section on general requirements and the guarantees to be given by producers, and a second on the particular requirements and guarantees for individual preparations, classified in groups. The principal insecticides are arsenicals, products containing nicotine, pyrethrum or derris, and tar distillates and other oil emulsions.

WIESMANN (R.). **Das Wirtspflanzenproblem der Kirschfliege, *Rhagoletis cerasi* L.** [The Problem of the Food-plants of the Cherry Fly, *R. cerasi*.]—*Landw. Jb. Schweiz* **51** Heft 9 pp. 1031–1044, 6 figs., 25 refs. Bern, 1937. (With a Summary in French.)

After reviewing similar work in Germany [R.A.E., A **22** 247; **23** 225, etc.], the author records investigations in 1932–36 on the fruits infested by *Rhagoletis cerasi*, L., in Switzerland. In nature, the larvae were found to occur, not only in cultivated cherries, but also in wild cherries and the fruits of *Lonicera xylosteum* and *L. tartarica*. They were not observed in fruits of *L. caprifolium*, *L. nigra*, *Rhamnus frangula*, *Prunus padus*, *Sorbus aucuparia*, *Cornus mas*, *Mahonia aquifolium* or *Berberis vulgaris*. *Lonicera* was not attacked in 1932–34 and was only slightly so in 1935 (when the crop of edible cherries was very poor) and 1936 [cf. **25** 3]. There was no morphological difference between flies originating from *Lonicera* and from cherry, and females from either fruit oviposited in the other [cf. **22** 248]. In the laboratory, adult emergence of flies originating from cherry was completed in 18 days with a peak on the 11th day, but that of flies from *Lonicera* began 3 days later and continued for 43 days, while the peak, which occurred on the same date, was much less accentuated. This would indicate a certain adaptation of *R. cerasi* to the fruits of *Lonicera*, which ripen rather later than those of cherry and in an irregular manner, though it is also possible that the inferior nutritive quality or later ripening of *Lonicera* berries retards larval maturity and thereby influences adult emergence in the following year. Two Ichneumonids, *Opius rhagoleticolus*, Sachtl., and an undetermined species, were bred from the pupae from *Lonicera*. Infestation experiments were made with 25 wild and cultivated fruits, and oviposition occurred in 19 of them. In some fruits the eggs hatched, but it was only in cherry and the two species of *Lonicera* tested (*L. tartarica* and *L. buchmani*) that mature larvae and pupae were produced. Pupae of *Acidia (Myiolia) lucida*, Fall., were common in berries of *Lonicera* collected in the field. It is concluded that in Switzerland *Lonicera* may be disregarded as a source of infestation of edible cherry by *R. cerasi*.

CARL (J.). **Démonstration de la cochenille floconneuse sur le houx.**—*Verh. schweiz. naturf. Ges.* **118** p. 159. Aarau, 1937.

Pulvinaria floccifera, Westw., recently found on holly in France [cf. R.A.E., A **25** 104] is recorded for the first time from the same food-plant in Switzerland.

[TARANUKHA (M. D.).] **Таpaнyxа (M. Д.). Methods for Determining the Feeding Rates of *Porthetria dispar* L.** [In Ukrainian.]—*Trav. Inst. Zool. Biol. Acad. Sci. Ukr.* **14** pp. 43–109, 6 figs., 7 graphs, 43 refs. Kiev, 1937. (With Summaries in Russian pp. 100–104 and English pp. 104–109.)

Experiments are described in which larvae of *Lymantria (Porthetria) dispar*, L., were fed on leaves of apple in order to study their rate of

feeding and the best method of determining it. Of three methods tested, the one that was most accurate and would be most suitable for studies in the field consisted in weighing the excreta of the larvae and multiplying their weight by the "coefficient of food assimilation" (the ratio of the weight of food consumed by the larvae to that of their excreta). It was found that the amount of food consumed increased with each successive instar in approximately geometrical progression. The average weights of food consumed by male and female larvae were 4.214 and 9.165 gm., respectively. There was a complete correlation between the weight of the food consumed by a larva and the increase in its body-weight; and each unit of weight of a pupa represented 8.77 units of food absorbed by the larva. The coefficient of food assimilation decreased as the larvae developed.

In estimating the possible extent of damage by the larvae of pests to stands of deciduous trees, it is necessary to take into account the fact that the degree of infestation affects the feeding rate of the larvae, which eat less and produce smaller pupae under crowded conditions when food is scarce. By counting and weighing the excreta falling on sheets under sample trees in a given time, it is possible to ascertain the instar and numbers of the larvae on the tree. The excreta of the larval instars of *L. dispar* are described, and a table shows the average weight ejected by them in 24 hours.

[IVANOV (S. P.) & ZHITKEVICH (O. N.).] Іванов (С. П.) і Житкевич (О. Н.). **A Survey of the Outbreak of *Loxostege sticticalis* L. in the main Sugar-beet Zone (Forest-Steppe of the Ukr.S.S.R., Kursk and Voronezh Regions R.S.F.S.R.) and in the adjoining Steppe Regions of the Ukr.S.S.R. in 1935.** [*In Ukrainian.*—*Trav. Inst. Zool. Biol. Acad. Sci. Ukr.* **14** pp. 111–168, 1 fig. map, 13 refs. Kiev, 1937. (With Summaries in Russian pp. 161–164 and English pp. 165–168.)

A detailed account is given of the local distribution, seasonal occurrence and abundance in 1935 of *Loxostege sticticalis*, L., in the Ukraine and the Provinces of Kursk and Voronezh, where sugar-beet is extensively cultivated. It is preceded by a brief survey of the conditions in 1934, when breeding was prolific over a large part of the forest-steppe zone, but not in some areas where weather conditions would have been favourable for it.

The flight of the moths in the spring of 1935 occurred in two distinct waves, before and after a spell of cold weather in the earlier part of June. The general direction of the second flight coincided with the wind, and this fact showed that swarms in localities in which weather conditions had been unfavourable for the development of the pest in 1934 were immigrants. The distance covered by them sometimes exceeded 95 miles [*cf. R.A.E., A* **24** 816]. The females of both waves of flight contained mature eggs and comprised 30–70 per cent. of the total number of adults. The resulting larvae were numerous both in the steppe and in the forest-steppe zone; a part of the progeny of moths of the second wave of flight entered a diapause and did not give rise to adults in 1935. Adults of the first generation emerged at the end of June or in July, but owing to the prevailing drought, the females were not prolific and many were sterile [*cf.* **22** 613; **25** 310]. The adults of the second generation appeared at the end of August or beginning of September, and in the steppe, where considerable rainfall

occurred at that time, matured their eggs and gave rise to numerous larvae.

Examination of the soil in autumn revealed considerable numbers of hibernating larvae in different steppe districts; in the forest-steppe zone they were abundant only in localities in which there had been rainfall during the adult flight. No outbreak occurred, however, in 1936, owing to the protracted cold in spring and to the dry hot weather in May-June. In spite of the abundance of the larvae in 1935, when as many as 80-250 per sq. yard occurred on beet, the losses caused to crops were small, owing to the intensive application of control measures.

[PARKHOMENKO (V. Yu.).] Пархоменко (В. Ю.). On the Injury to the Roots of the Pine (*Pinus silvestris* L.) by the Larvae of *Melolontha hippocastani* F. and its Dependence on the Number of Larvae in the Soil and on the State of the Tree. [In Ukrainian.]—*Trav. Inst. Zool. Biol. Acad. Sci. Ukr.* **14** pp. 169-196, 2 figs., 17 refs. Kiev, 1937. (With Summaries in Russian pp. 189-191 and English pp. 192-193.)

The investigations described were carried out in 1935 and 1936 in stands of pines 7-12 years old in the Ukraine to determine the damage caused by larvae of *Melolontha hippocastani*, F. Of the Lamellicorns found in the soil, this species constituted 78-97 per cent., and in 1935 most of the larvae were two years old. Their distribution in the forests depended on the amount of shade [cf. R.A.E., A **18** 270; **21** 123]; the severest infestation (8-33 larvae per square metre) invariably occurred in plots of moderate density with normally developed trees about 12 ft. high. Only 0.4-4 larvae per square metre were present in plots sparsely covered with weakened trees up to 5 ft. in height, and very few or none in open glades exposed to light. The presence of the larvae was due to the selection of the site by ovipositing females, as larval migration was negligible. Other species found were *Polyphylla fullo*, L., *Anoxia pilosa*, F., *Amphimallus solstitialis*, L., and *Anomala dubia aenea*, DeG., all of which mainly infested bare or sparse plots.

In the district where the small weakened trees occurred, their condition was chiefly due to inferior soil, the larvae being most numerous under healthy trees of normal height. In another forest, however, in which all the pines were of normal height, some were dried up owing to severe infestation of the roots by the larvae. It was found that the effect on the growth and development of pines of equal numbers of larvae of *M. hippocastani* depended on the interaction of different forest factors, particularly the degree of humidity of the soil, that affect the general condition of the trees. Pines with short vertical roots were severely damaged by only a few larvae, whereas those with long ones resisted as many as 8-27.8 per square metre. Injury to the roots was intensified by drought.

[TREĬMAN (F. S.).] Трейман (Ф. С.). On the Morphology and Biology of *Calandra oryzae* L. [In Ukrainian.]—*Trav. Inst. Zool. Biol. Acad. Sci. Ukr.* **14** pp. 259-277, 9 figs., 14 refs. Kiev, 1937. (With Summaries in Russian pp. 273-275 and English pp. 275-277.)

An account is given of observations on the development of *Calandra oryzae*, L., reared in the laboratory in unpolished rice. Polished rice

was found to be almost immune from infestation, probably because it is dried and the grains are thus too hard for the weevil to oviposit in them [cf. *R.A.E.*, A **22** 136]. Eggs were laid in the grains, usually singly, though up to 4 larvae sometimes occurred in one grain. At 16–18°C. [60.8–64.4°F.] and 50–55 per cent. relative humidity, the life-cycle lasted 3 months; at 22–23°C. [71.6–73.4°F.] and 70–75 per cent. humidity, it lasted 2–2½ months; and at 27–28°C. [80.6–82.4°F.] and 90–95 per cent. humidity, it lasted approximately one month, of which 6–7, 18–20 and 5–7 days were occupied by the egg, larval and pupal stages, respectively, and 2–3 days were spent by the young adults in the grains before emerging. The adult weevils required to feed for a few days to become sexually mature. At 22–23°C. some adults lived a year, and the rate of development was quickest in June–November and slowest in February–June. The author's observations on the relations between temperature and development largely confirmed those of Bodenheimer [cf. **15** 373]. The number of adult progeny of individual females averaged 95.8 at 22–23°C. and 148 at 27–28°C. At these temperatures the numbers of generations in a year were 3 and 5, respectively.

The weevils appear unable to withstand overcrowding, as they died in numbers when kept under such conditions in closed jars, though food was abundant, and in nature they begin to disperse as soon as they become numerous.

[EMCHUK (E. M.).] **Емчук (Е. М.). Some Data on the injurious Entomofauna of the Truck Farms and Orchards of the Desna River Region.** [In Ukrainian.]—*Trav. Inst. Zool. Biol. Acad. Sci. Ukr.* **14** pp. 279–282. Kiev, 1937. (With Summaries in Russian and English p. 282.)

This paper contains a list of 32 species of insect pests observed in August 1933 on hemp, cabbage, potato and fruit trees in an area in north-western Ukraine, with brief notes on the more important of them. These were: *Phorbia* (*Hylemyia*) *brassicae*, Bch., *Pieris brassicae*, L., and *Barathra brassicae*, L., on cabbage, *B. brassicae* also attacking tobacco, hemp and other crops; *Pyrausta nubilalis*, Hb., which entirely destroyed over 24½ acres of hemp, from 5 to 12 larvae occurring in each stem; *Hyponomeuta padellus malinellus*, Zell., and *Cydia* (*Laspeyresia*) *pomonella*, L., on apples; and *Lyonetia clerkella*, L., which mined the leaves of cherries in one village.

[KORAB (I. I.).] **Кораб (И. И.). Mites on Beet Seeds and Means of combating them.** [In Russian.]—*Nauch. Zap. sakharn. Prom.* **14** no. 2 pp. 57–69, 2 graphs. Kiev, 1927.

In the Russian Union, stored beet seeds are sometimes infested by mites, many of which have not been identified. A list is given of the nine commoner species, of which five are Tyroglyphids. The damage caused by granary mites in general is discussed, and it is pointed out that they are not able to penetrate undamaged grain or beet seeds [cf. *R.A.E.*, A **25** 130; **26** 96]. In beet seeds, the mites become abundant only if the moisture-content exceeds normal (13 per cent.). In investigations, the optimum conditions for their increase were 18–25°C. [64.4–77°F.] and 16–24 per cent. moisture-content of the seeds. At temperatures below 12–10°C. [53.6–50°F.], the activity of the mites almost ceased, and

though females continued to oviposit, the eggs did not hatch. Mites that occurred on the surface of heaps of seed survived temperatures as low as -22°C . [-7.6°F .] and those inside the heaps even -30°C . [-22°F .]. Most of the mites, including the hypopi and eggs, were killed when the beet seeds were heated and kept at 40°C . [104°F .] for 15–30 minutes, and all were killed in seeds kept at 55°C . [131°F .] for 10 minutes. The flour or grain mites, which are the most injurious, usually occur in the seed heaps at a depth of 20–30 ins. The predatory mites, especially *Cheyletus eruditus*, Schr., are the most resistant to different conditions of storage.

The most reliable method of safeguarding beet seeds from infestation is to reduce their moisture-content to 10 per cent. It is, therefore, advisable to dry the seeds periodically in the granaries by means of hot air. In a series of tests under practical conditions on the effectiveness of fumigating infested beet seeds the amounts of carbon bisulphide (per 10 cu. ft.) and durations of exposure required to give complete mortality of the mites were 2.5 oz. and 96 hours at 10°C . [50°F .]; 2 oz. and 72 hours at 15°C . [59°F .], and 1.5 oz. and 24 hours at temperatures above 20°C . [68°F .]. When the storage space is filled with seed, the amount of fumigant should be calculated for the weight of the seed, 1 part carbon bisulphide per 1,000 by weight being required for an exposure of 72 hours at 15°C .

Chloropicrin reduced the germination of the seeds if their moisture content was above 11 per cent.; moreover, the treated seeds have to be thoroughly aired or cleaned. Powdered calcium cyanide, containing 23 per cent. HCN [*sic*], killed all stages of the mites in 48 hours when mixed with the seeds at the rate of 2 parts per 1,000 by weight, the seeds being covered with a tarpaulin. The germination of the seeds was not impaired, provided that the moisture content did not exceed $12\frac{1}{2}$ per cent. Sulphurous slag, which gives off hydrogen sulphide [*cf.* 258], killed the mites in 72 hours when used at the rate of 1.5–2 parts per 1,000; it was placed in small bags in heaps of seed covered with tarpaulins.

Naphthalene mixed with the seeds in the proportion of 1 : 2,000 by weight did not kill the eggs or hypopi and its action on the other stages of the mite only lasted about 3 months. Paradichlorobenzene was unsatisfactory owing to its high volatility. Of other substances tested, ground sulphur (1 : 1,000) and magnesium carbonate (4 : 1,000) were the most effective, no mites surviving in the seeds 20 days after treatment.

[YARMOLENKO (I. M.). Яромленко (И. М.). Ways of using poisoned Baits for the Control of Larvae of *Euxoa segetum* Schiff., on Winter Crops. [*In Russian*.]—*Nauch. Zap. sakharn. Prom.* 14 no. 2 pp. 71–72. Kiev, 1937.

In October 1935, poison baits were tested in Kiev Province against larvae of *Euxoa segetum*, Schiff., on heavily infested plots of autumn-sown wheat. The baits consisted of 100 parts by weight of leaves or chopped roots of beet dusted with 1 part calcium arsenite or 2 parts sodium fluoride. The arsenite proved to be the more effective poison and the chopped roots the more attractive bait. When the baits were broadcast over the plots they gave mortalities in the neighbourhood of 50 per cent. They were less effective when

placed in small heaps on the plots or when used in trap ditches ; the latter did not catch many of the larvae, which had plenty of food and so did not move about much.

MENOZZI (C.). Curculionidi della sottofamiglia Cleoninae (Coleoptera-Curculionidae) che si notano nelle colture della bietola da zucchero in Italia e loro rapporti con questa pianta. [Curculionids of the Subfamily CLEONINAE observed in Fields of Sugar-beet in Italy and their Relation to this Plant.]—*Industr. saccharif. ital.* **30** no. 5 repr. 12 pp., 7 figs., 10 refs. Genoa, 5th May 1937. [Recd. December 1937.]

The Cleonine weevil injurious to sugar-beet in Italy is *Cleonus* (*Conorrhynchus*) *mendicus*, Gyll. Of a number of other species found in beet fields in investigations since 1929, *Cleonus piger*, Scop., was not plentiful and only once was an adult seen feeding on a beet leaf. The biology of *C.* (*Conorrhynchus*) *luigionii*, Sol., resembled that of *C. mendicus* [cf. *R.A.E.*, A **18** 561], but the adults remained longer in their winter quarters, appearing when the beet plants were already well developed. The larvae readily adapted themselves to a loose, sandy soil. *C.* (*Leucosomus*) *pedestris*, Poda, was only occasionally found in the fields, and in captivity fed neither on beet nor on other Chenopodiaceae. *C.* (*Mecaspis*) *alternans*, Hbst., was often observed in central Italy, but over 5 years was only 6-7 per cent. as numerous as *C. mendicus*. The adults fed on beet leaves in captivity, but did so very rarely in nature. Adults of *C.* (*Chromoderus*) *fasciatus*, Müll., were observed feeding on beet leaves and, in 1935, larvae were discovered tunnelling the roots, but the injury was negligible. *C.* (*Cyphocleonus*) *tigrinus*, Panz., and *C. morbillosus*, F., did not attack beet.

SILVESTRI (F.). I nuovi impianti di oliveti in relazione alla mosca delle olive. [New Plantations of Olives in Relation to the Olive Fly.]—*Olivicoltura* 1936 no. 12 pp. 3-7, 5 figs. Rome, December 1936. [Recd. December 1937.]

The losses caused by the olive fly [*Dacus oleae*, Gmel.] in Italy can be diminished by a number of practices. Olive trees should be planted on hill-sides at some altitude so that the ripening of the fruit is delayed. The adult flies appear in March and early April and, if no olives of the preceding year are still available, they have to wait until June or July in order to oviposit and their instinct leads them to places where the fruits develop early. If some fruits are still on the trees in spring, the flies oviposit in them and 1 or 2 generations may be produced between April and June. A new plantation of olives should consist exclusively of late varieties, except, perhaps, for one tree of an early variety in every hundred to serve as a trap. Olive trees should not be associated with figs or grape-vines, because the adult flies feed on sugary substances exuded by such plants. Plants forming the natural vegetation of a locality should be left along the edges of an olive plantation, as the Hymenoptera that parasitise the larvae of the fly from July to September maintain themselves during the remainder of the year on insects infesting such wild plants. All the olives should be removed, if possible by hand instead of by beating them from the trees, not later than the end of March. Olives should be crushed as

soon as they are picked, but if they are stored temporarily, the room should have a cement floor and screened windows so that the pupae can be collected easily and any flies that emerge cannot escape.

PAOLI (G.). **Studi sulle cavallette di Foggia** (*Dociostaurus maroccanus* Thnb.) e sui loro oofagi (Ditteri Bombiliidae e Coleotteri Meloidi) ed Acari ectofagi (Eritreidi e Trombidiidi). [Studies on *D. maroccanus* in the Province of Foggia and on its Egg-parasites and the Mites ectoparasitic on it.]—*Redia* **23** pp. 27–206, 99 figs., 3 pls., 7 pp. refs. Florence, 1937.

This paper is based on field observations made in 1917–19 in the Foggia Province of Italy, where *Dociostaurus maroccanus*, Thnb., phase *gregaria*, occurred on the then uncultivated area lying between Foggia, Troia and Ascoli Satriano. The country has been under grazing from antiquity, and the vegetation, which is described, consisted mainly of low-growing plants, with grasses and Plantaginaceae predominating. The meteorological data for Foggia station for the period under review are recorded, and a bioclimatograph is given [cf. *R.A.E.*, A **20** 548] of the developmental stages under local conditions. The climate, soil and vegetation of the infested zone do not differ from those of the surrounding country, where no breeding takes place. The history of invasions by *D. maroccanus* in the whole of Apulia, dating back to 1577 is reviewed; the last great outbreak occurred in 1929 [19 75].

Very detailed descriptions and illustrations are given of the egg-pods, the eggs and all the instars, with records of the biometrics of the relative growth of different parts throughout development, including a detailed scheme for the growth of antennae, and of the weights of the two sexes in each instar. External processes connected with embryonic development and conditions of hatching, which begins in the second half of April and continues for 20 days, are discussed.

Hoppers hatching from dense egg-deposits soon crowd into groups; in the early instars, they feed mainly on *Plantago serraria*. A list is given of wild plants eaten and avoided by *D. maroccanus*; in cultivated Graminaceae the green leaves are eaten completely, and in oats the peduncles of the heads are bitten away. The hoppers complete their development in about 50 days, during which period they can traverse nearly $2\frac{1}{2}$ miles, and the first adults appear in mid-June, the males 2–3 days before the females. The adults soon begin to undertake irregular flights, directed centrifugally from the breeding area, and invade the cultivated fields. Sexual maturity is reached in about 8 days, after which the flights turn back to the original breeding area, where the vegetation is now dry and the ground practically bare. Here the locusts congregate in dense circular groups, 1–2 yards in diameter, and oviposit. The mechanism of oviposition is described in great detail and illustrated; a female can lay 3–5 egg-pods, or up to 100 eggs. It is estimated that 1,000–1,200 first-instar hoppers occupy an area of 16 sq. ins.; the number decreases to 60–80 by the fifth instar and to 10–15 in the adult stage, so that an area occupied by a band increases a hundredfold, a fact that must be taken into account when organising control measures. It is considered that careful control, assisted by destruction by natural enemies, may reduce the locust population to 10 per cent. of the numbers hatched, but this number is again multiplied by about 25 in the next generation.

A list of all the egg-parasites of *D. maroccanus* and *Calliptamus italicus*, L., recorded in Italy is given. Three species of Bombyliids, *Anastoechus nitidulus*, F., *Cytherea obscura*, F., and *Systoechus ctenopterus*, Mik., were bred from the egg-pods of *D. maroccanus* in Apulia. The adults of *Cytherea* and *Systoechus*, all stages of which are described and figured, appear early in June and disperse in search of flowers of Labiatae and Compositae, on which they feed. Oviposition was not observed, but in July some fully-grown larvae were found in locust egg-pods. The whole larval development is completed in one egg-pod; between late August and December the larvae leave the egg-pods through large oval holes in their sides and hibernate in small cells in the ground till April, when they burrow vertical canals upwards and pupate in them near the surface, 15–20 days before adult emergence.

The developmental stages and colour variations in the adults of *Mylabris variabilis*, Pall., which also parasitises the eggs, are described and figured. The adults emerge in late May and disperse in search of flowers of Compositae. The females lay 30–40 eggs at a time, and egg-laying occurs at the same period as that of the locusts, but is not confined to oviposition sites of the latter. After incubation for over 20 days, the triungulins enter the locust egg-pods by making a hole 0.5 mm. in diameter in the upper half of the pod. The feeding larva destroys the egg-membranes and emits excreta, by which an egg-pod that has been occupied by it can be recognised. After it reaches the fifth instar, the larva leaves the egg-pod through an oval hole in the side (which is larger and less regular than that formed by Bombyliids) and burrows in the ground in the depth of 4 ins. There it transforms into the sixth, immobile, instar in which the winter is passed, and, in the spring, into the seventh instar, which lasts 10–30 days. The pupal stage lasts about 2 months.

Analysis of the percentage of parasitism in various egg-deposits showed that this increases from year to year if eggs are laid in the same area, but in newly infested localities it is usually small. This suggests that the egg-parasites do not follow the locust swarms, but oviposit indiscriminately. Direct observations demonstrated that egg-parasites lay at different times of the day from locusts; their effectiveness as controlling agents is further reduced because they infest the egg-pods of many other Acridids and their distribution is governed mainly by physical environmental factors and has no direct relation to that of the locust.

In a concluding part of the paper, detailed descriptions are given of six mites found on grasshoppers, of which four are new species, one of them belonging to a new genus. All but the last were obtained from *D. maroccanus*.

BOVEY (P.). **La tordeuse orientale du pêcher** (*Laspeyresia molesta*, Busek), **nouvel ennemi des cultures fruitières en Suisse.**—*Bull. Soc. vaud. Sci. nat.* **60** no. 246 pp. 63–68, 2 figs., 8 refs. Lausanne, 1938.

Investigations in the summer of 1937 showed that *Cydia* (*Laspeyresia*) *molesta*, Busck, had penetrated from north Italy into Switzerland, where it was fairly widespread on peaches in the Ticino. The fact that it was more numerous near towns suggests that it may also have been introduced in Italian peaches in 1936. Peaches apparently infested

by this species were also on the market in and near Lausanne, and a peach tree with twigs showing evidence of having been attacked by it was found there in August. Further investigations are being made. The literature on the distribution of *C. molesta* is reviewed, and notes are given on its bionomics.

HADORN (C.). **Neuzeitliche Bekämpfung des Ulmenblattkäfers** (*Galerucella luteola* Mull.). [Modern Control of the Elm Leaf Beetle, *G. luteola*.]—*Schweiz. Z. Forstwes.* 1937 no. 3 repr. 12 pp., 12 figs. Bern, 1937.

Ornamental elms in Switzerland have been defoliated by *Galerucella luteola*, Müll., the adults of which appear from their winter quarters early in April, and, after pairing, oviposit in May. In preliminary experiments in 1935, a proprietary derris dust killed the adults and larvae by contact, adults dying in 5–7 hours, young larvae in 1 hour, and mature larvae in 3–5 hours. In 1936, single applications of this dust were made at times when practically all the larvae had hatched. Examinations of twigs sent in weekly, first bearing eggs and then young larvae, enabled the correct dates to be fixed; they were 1st July at Geneva and 7th July at Morat. Power dusters were used, in conjunction with fire-brigade ladders for tall elms. Inspection of the trees later in the year showed that the treatment was successful.

MADEL (W.). **Neue und wenig bekannte Beobachtungen über den Australischen Diebskäfer** *Ptinus tectus* Boield. [New and Little Known Observations on *P. tectus*.]—*Mitt. Ges. Vorratsschutz* 13 no. 6 pp. 70–73, 3 refs. Berlin, November 1937.

The author records instances observed in Germany of larvae and adults of *Ptinus tectus*, Boield., feeding on the dried leaves and flowers of various plants, including *Hyoscyamus niger* and *Datura stramonium*.

PAILLOT (A.). **Nouveau type de pseudo-grasserie observé chez les chenilles d'Euxoa segetum**.—*C. R. Acad. Sci. Fr.* 205 no. 24 pp. 1264–1266, 1 ref. Paris, 1937.

Studies in 1937 on the infectious diseases of larvae of *Euxoa segetum*, Schiff., revealed a new one, designated pseudograsserie 3, distinctly different from 1 and 2 [cf. *R.A.E.*, A 24 78]. The cause is an ultravirus that is visible at an ordinary magnification of the microscope. The larvae generally succumb to the infection without always presenting the whitish tinge that is the most evident symptom of the other two forms of pseudograsserie. Shortly after death the body becomes black and deliquescent. The disease appeared to be extremely contagious both intestinally and through the blood. Cellular lesions were hardly visible till 10–12 days after contamination at an average temperature of about 10°C. [50°F.].

DICK (J.). **Oviposition in certain Coleoptera**.—*Ann. appl. Biol.* 24 no. 4 pp. 762–796, 19 figs., 61 refs. Cambridge, November 1937.

The following is based on the author's summary: Methods for satisfactory studies of oviposition of *Tenebrio molitor*, L., *Tribolium confusum*, Duv., *Sitodrepa panicea*, L., *Lasioderma serricorne*, F., and *Dermestes vulpinus*, F., are described. From a survey of the literature,

Coleoptera are divided into four categories according to their oviposition cycles, *viz.*: short-lived species that lay all their eggs in a few days; long-lived species that lay continuously over a long period; rather short-lived species that lay batches of eggs at short intervals; and long-lived species with two or more periods in which oviposition is more or less continuous separated by a long period in which there is no oviposition. Descriptions are given of the normal oviposition cycles of *L. serricornis* and *S. panicea*, which belong to the first group, and *T. confusum* and *Tenebrio molitor*, which belong to the second group, although *Tenebrio* is somewhat intermediate. Records of parthenogenesis in Coleoptera suggest that it is almost confined to Curculionids, and even in them it is rare. Of the five species studied by the author, virgin females laid no fertile eggs, and only those of *Tribolium* and *Tenebrio* laid any eggs at all. In many beetles that will copulate more than once, a single mating ensures fertility of all or most of the eggs. In certain species, however, the oviposition rate falls if there are not repeated matings. This is the case with *Tribolium*, where a second mating, even in females still laying fertile eggs, has a marked stimulatory effect.

There are usually both upper and lower limits of temperature for oviposition. In *Tenebrio* and *Tribolium*, it appeared that the upper limit was determined by the temperature that was soon lethal to the beetles; the lower limit lay between 14 and 16°C. [57·2 and 60·8°F.]. A sudden drop in temperature from 27 to 18°C. [80·6 to 64·4°F.] had a marked stimulatory effect on the oviposition rate of *Tribolium* when the beetles had been returned to a temperature of 27°C. The conditions of atmospheric humidity and of moisture-content of food suitable for different species are very varied. Certain species such as *D. vulpinus* must drink water in order to lay normally. *Tribolium* can live and lay more than half of the normal number of eggs in a flour and in an atmosphere approaching complete dryness. *Tenebrio* requires no water to drink, but even in a 20 per cent. relative humidity (at 27°C.) oviposition is very greatly reduced. An account is given of experiments on the influence on oviposition of food and oviposition sites, and the changes in the appearance of the reproductive organs of *Tribolium* during the life of a female are described.

HAYHURST (H.). **Insect Infestation of Stored Products.**—*Ann. appl. Biol.* **24** no. 4 pp. 797–807, 2 pls., 9 refs. Cambridge, November 1937.

This is a list, arranged in systematic order, of insects and other Arthropods found in stored products in warehouses, in transit and awaiting storage, on the London, Midland and Scottish Railway during the past 10 years. It shows the materials in which each species was found by the author, together with other records of its food substances and its general distribution.

BLISS (C. I.). **The Calculation of the Time-mortality Curve.**—*Ann. appl. Biol.* **24** no. 4 pp. 815–852, 5 figs., 19 refs. Cambridge, November 1937.

Statistical methods are described for calculating the "time-mortality" curve, which can be constructed from the results of a toxicity test measured in terms of the reaction time by plotting the data so as to show

the percentage of animals that has reacted at different times from the beginning to the end of the experiment. Time-mortality curves that are incomplete or truncated occur when reaction times are not recorded for all individuals in the experiment either for biological or experimental reasons. W. L. Stevens describes a new method for computing these curves.

BYWATERS (M. F.) & POLLARD (A. G.). **Studies in Soil Fumigation.**

I. Preliminary Observations.—*Ann. appl. Biol.* **24** no. 4 pp. 883–894, 2 figs., 6 refs. Cambridge, November 1937.

The following is the authors' summary: Results of preliminary tests of possible methods of investigating the factors controlling the distribution of fumigant vapour in soil are described. Sufficiently uniform and reproducible conditions of pore space in soil may be secured by packing at definite pressures and with a controlled moisture content. A rapid approximate method for determining pore space is described. Carbon disulphide may be satisfactorily removed from soil by aeration methods, and determined, after absorption in alcoholic potash, by the iodometric method. Under the conditions of the experiment (injection of 2 oz. of carbon disulphide at 5 in. depth) the zone of high concentration of the vapour occurs at the level of injection and some 6–7 in. below it. Above the injection concentrations are definitely low. Although movements of carbon disulphide by diffusion are probably dominant factors controlling its distribution in soil, the operation of a more slowly acting factor (possibly biological) effecting destruction of the vapour is indicated.

HIGGINS (J. C.) & POLLARD (A. G.). **Studies in Soil Fumigation.**

II. Distribution of Carbon Disulphide in Soil fumigated under various Conditions.—*Ann. appl. Biol.* **24** no. 4 pp. 895–910, 5 figs., 5 refs. Cambridge, November 1937.

The following is the authors' summary: Experiments on the lines indicated in the preceding paper but with improved methods confirm that the depth-distribution of carbon disulphide in soil fumigated by injection is characterised by a high concentration in the zone of injection and immediately below it, a rapid decrease in concentration as the surface is approached, a somewhat slower decrease with depth below the zone of injection, and a time-concentration curve for each individual layer representing a sharp rise to a maximum concentration followed by a slower decline to a low level which is normally reached in about 24 hours. Variations in the depth of injection raise or lower the zone of high concentrations without appreciably affecting that in the surface 0–3 in. layer. Increased amounts of carbon disulphide per injection increase the persistence of the effective concentration of fumigant, without causing any marked change in distribution or in the maximum concentrations attained. Experimental data indicate that the loss of fumigant from treated soil occurs very largely *via* the soil surface. Effective concentrations of carbon disulphide could not be produced in the surface layer by variation of the depth or amount of the injections nor by covering the surface with sacking. The nature of the concentration gradients of carbon disulphide in soil suggests that movement of the vapour is largely a simple diffusion

process, but that in coarse textured or loosely packed soils a gravitational flow (as of a viscous fluid) may occur to a limited extent. There is no evidence that such gravitational flow proceeds to any considerable extent. The concentration of carbon disulphide is uniformly low at all depths after about 24 hours.

FRAPPA (C.). **Note sur un parasite des agrumes à Madagascar.**—
Agron. colon. no. 238 pp. 103–114, 6 refs. Paris, October 1937.

An account is given of investigations carried out since 1930 on *Papilio demodocus*, Esp., in Madagascar, where it breeds on cultivated *Citrus* and possibly also on other rutaceous plants. All its stages are described. It is abundant in the central regions in the gardens and low ground round villages, and is particularly numerous on the slopes in the east of the island. It is also found in clearings and along streams in the forests. Adults first appear on the central plateau in October, as soon as the hot rainy season is well in progress, and begin to oviposit 8–10 days after emergence. In rearing experiments, the egg, larval and pupal stages lasted 4–5, 18–20 and 15–25 days, respectively. The life-cycle was completed in about 52–56 days at Tananarive, so that there are probably 3–4 generations a year in the field. Pupation occurs on the food-plant, and pupae of the last generation hibernate from May or June, adults emerging in October. Infestation is generally very localised; it is most severe in February and March, at the end of the rainy season, when the last generation is present. Well-grown trees are not much weakened, but a few larvae can quickly defoliate seedlings, newly grafted plants or those just planted out, and the set-back is very severe.

In nurseries and newly established orchards, hand-collection of the larvae at regular intervals is recommended. Sprays employed against them in other countries [*R.A.E.*, A 19 192; 22 119] are reviewed. In the laboratory tests, an emulsion of ground-nut oil, kerosene, soap and water (3 : 1 : 2 : 200) killed all the larvae with which it came in contact, in 2–18 hours. Records of parasites of *P. demodocus* are also briefly reviewed; in Madagascar many individuals of a Tachinid were reared from the larvae.

FUKUSHI (T.). **An Insect Vector of the Dwarf Disease of Rice Plant.**—
Proc. imp. Acad. Japan 13 no. 8 pp. 328–331, 1 fig., 1 ref. Tokyo, October 1937.

It has generally been thought that the only vector of dwarf disease of rice in Japan is *Nephotettix bipunctatus (apicalis) cincticeps*, Uhl. [cf. *R.A.E.*, A 23 208], but the experiments here described showed that it can also be transmitted by another Jassid, *Deltocephalus dorsalis*, Motsch. The insects were reared on diseased rice plants and transferred to healthy ones in the adult stage. Of 112 tested in 1936, 45 killed the plants on which they were fed before it could be ascertained whether the latter were infected, and 66 were not infective, but 1 infected 21 out of 25 plants, on each of which it was fed for a day. Of 175 tested in 1937, 61 killed the plants, 97 were not infective and 17 transmitted the disease. The proportion of infective insects in 1937 was not materially less than it has been in experiments with

Nephotettix. Some of the non-infective examples of *Deltocephalus* produced white stripes on the foliage indistinguishable from the early manifestation of dwarf disease.

Codling Moth and Black Spot Control. Apple and Pear Demonstration Plots, 1936-37.—*J. Dep. Agric. Vict.* **35** pts. 8-9 pp. 377-394, 441-452, 19 figs. Melbourne, 1937.

An account is given of experiments on the control of *Cydia pomonella*, L., and black spot on apple and pear in demonstration plots in different districts in Victoria in 1936-37. Infestation was not as serious as usual, and where the sprays were properly applied, good control was obtained. All the lead arsenate sprays used consisted of 5 lb. paste in 80 gals. with $\frac{1}{2}$ lb. calcium caseinate as spreader. The schedule on pears included one calyx and four cover sprays of lead arsenate. Two schedules were used for apples, the sprays for black spot being the same in both. The first included one calyx spray and several cover sprays of lead arsenate; the second included two calyx sprays and one cover spray of lead arsenate followed by cover sprays of white oil (1:60). The differences in infestation were scarcely significant owing to the relatively low codling moth activity, and the effects of the white oil sprays, which are essentially ovicides, were not outstanding. Bait traps helped considerably in timing the oil sprays. Straight-sided glass jars holding about $1\frac{1}{2}$ pints were used for the baits. Cider, 1:20, gave the best results, closely followed by molasses, 1:16; malt vinegar, 1:10, was less attractive, particularly during the summer months when the vinegar was liable to ferment and form a skin on the surface of the liquid. Preliminary tests were also carried out with wine vinegar, the lees from sweet wine rackings, golden syrup and unfermented apple juice; all these were superior to malt vinegar during the summer, but slightly less efficient than cider. About 6,500 trees were banded with corrugated cardboard treated with beta-naphthol in oil and, during the season, about 50,000 larvae were trapped. In no case did the emergence of moths exceed 4 per cent. of the larvae in the bands. The costs of spraying in all districts are discussed in detail.

PESCOTT (R. T. M.) & MILLER (L. W.). Codling Moth and Williams Pears. Control Methods Investigated.—*J. Dep. Agric. Vict.* **35** pt. 10 pp. 501-512, 9 figs., 4 refs. Melbourne, 1937.

In laboratory studies of the life-history of *Cydia pomonella*, L., on pear in Victoria in the season 1936-37, 7.14 and 87.72 per cent. of the larvae of the first and second broods, respectively, entered hibernation and the second-generation adults that emerged did not oviposit. In the orchard there were two broods, with no evidence of the occurrence of second-generation adults in late summer; the first moths were trapped on 12th October.

On an experimental plot, tests were carried out with 8 spraying schedules, including 1-3 calyx and 1-3 cover sprays of lead arsenate. Infestation in sprayed blocks varied from 5.49 to 11.10 per cent., the best results being obtained with 2 calyx and 2 cover sprays of 8 lb. lead arsenate paste in 80 gals. water. There was no significant difference in the degree of control obtained with this programme and one of 4 sprays of 5 lb. lead arsenate paste in 80 gals. water. Control was not significantly increased by the addition of 1 pint nicotine sulphate

or white oil to the latter spray. The arsenic residue resulting from the different schedules varied from 0.009 to 0.016 grains As_2O_3 per lb. fruit at the time of the first picking, only three programmes giving residues below the prescribed limit of 0.01. As additional sprays are applied between the first and second pickings in two of these three schedules, only the third, consisting of 2 calyx and 1 cover spray of lead arsenate, 5 lb. paste in 80 gals. water, would give residues conforming to regulations at the second picking.

In experiments on 4 types of bands, the best results were obtained with Hessian cloth, 10.1 larvae per band being trapped. Corrugated cardboard bands treated with beta-naphthol came next in efficiency; 3.55 larvae per band were trapped in them, and the mortality rate of these was 76 per cent.

Larvae of *C. pomonella* were preyed on by the Carabid, *Laemostenus complanatus*, Dejean, and were parasitised by a variety of *Brachymeria* (*Chalcis*) *victoria*, Gir. *Pseudanognmus stironotus*, Cameron, was reared from the pupae.

Cydia molesta, Busck, was recorded on pears in Victoria for the first time.

JENKINS (C. F. H.). **The Plague Grasshopper** (*Austroicetes jungi* Branesik).—*J. Dep. Agric. W. Aust.* (2) **14** no. 4 pp. 367–380, 3 figs., 3 maps., 9 refs. Perth, W.A., December 1937.

Austroicetes jungi, Branc., was reported in the wheat belt of Western Australia in 1922 and by 1925 had become abundant and injurious. Isolated outbreaks occurred in subsequent years, but widespread damage was not sustained till 1935, after which the situation became increasingly worse [cf. *R.A.E.*, A **25** 634]. The appearance and habits of the adults, oviposition, and the egg and egg-pod are briefly described.

There is one generation a year. The eggs are laid in September–November and hatch in July; the hopper stage lasts about 8 weeks, and the adults live for about 6. Eggs are laid for preference in hard undisturbed soil and cannot develop if conditions are too moist or too dry. Early autumn rains do not favour the development of outbreaks, for they either cause early hatching, in which case the hoppers have to contend with severe winter conditions, or increase the mortality among the eggs; during drought years, the eggs hatch after light winter rains, and development is favoured by mild weather. The rainfall in infested areas since 1935 is analysed by means of maps, which show the prevalence of drought conditions; in general, the areas of greatest infestation were associated with the belt where the rainfall between January and July was less than 10 ins. The areas of injury by the grasshopper have gradually moved westwards, for the conditions favouring its successful development have done likewise, and the normal local population has multiplied so as to assume outbreak proportions. Another factor favouring the outbreaks has been the extension of fallow lands by the abandonment of areas cleared and cultivated before 1929, which form a suitable habitat for breeding.

Natural enemies include a Bombyliid, *Cyrtomorpha flaviscutellaris*, Roberts, which is widespread in Western Australia and destroys the eggs, Trombidiid mites observed on hoppers, and a number of birds and native mammals. Egg-deposits were effectively destroyed by ploughing, while hoppers were controlled by soap sprays, poison sprays of 1 lb. sodium arsenite and 4 lb. molasses in 14 gals. water,

and baits of $\frac{1}{2}$ lb. sodium arsenite, 25 lb. bran, 6 lb. molasses and $2\frac{1}{2}$ gals. water, this quantity being sufficient to treat one acre.

KING (K. M.). **Summary of Insect Outbreaks for 1935.**—*Rep. Dep. Agric. Saskatchewan 1935-36* pp. 138-139, 2 figs. Regina, 1936. [Recd. December 1937.]

KING (K. M.). **Summary of Insect Outbreak, 1936.**—*Op. cit.* 1936-37 pp. 82-83, 1 fig. Regina, 1937.

These reports from Saskatchewan deal with insect outbreaks in 1935 and 1936. Tables show the estimated reductions in crop yield and the estimated money losses caused by cutworms, wireworms and grasshoppers on all grain and field crops, and the wheat-stem sawfly [*Cephus cinctus*, Nort.] on wheat. The percentage reduction in crop yield caused by these pests throughout the province and the value of the damage were estimated at 12.25 and about £3,000,000 in 1935 and 9.15 and about £2,700,000 in 1936. Damage occurred chiefly in the prairie districts; in 1935 the crop was reduced by about 20 per cent. in the south-central and south-western areas, and in 1936 the reduction amounted to about 33 per cent. in the districts where the drought was most severe. In 1935, grasshoppers were again the chief pest, although they were less abundant than in 1934. As a result of late migrations from land that was being summer-fallowed, much of the damage was to ripening crops. A wet spring and late hatching caused a general neglect of control measures that were applied to great effect in localities where infestation was initially more severe. In 1936, grasshoppers only ranked third among the pests, partly owing to an effective campaign in the north-west. Crop losses valued at about £800,000 and £890,000 were caused by wireworms in 1935 and 1936, respectively. Wireworms have become more abundant in most parts of the province, particularly in land that has been idle for a few seasons or where summer-fallow has been very weedy, and in 1936 they were more injurious than any other single pest. Moreover, surveys have indicated that the damage has been underestimated. The cutworms injurious to crops included the pale western cutworm [*Porosagrotis orthogonia*, Morr.], which was abundant in the south-west in both years and in 1936 in the west-central and south-central districts also; and the red-backed cutworm [*Euxoa ochrogaster*, Gn.], which was the most injurious species in the north-west in 1935 and in the north-central districts in 1936. *Cephus cinctus* was the second most important pest in 1936, and infestation was generally greater than in 1935; it caused damage estimated at nearly £800,000.

Minor pests in 1936 included the potato beetle [*Leptinotarsa decemlineata*, Say], which was exceptionally abundant, especially in the north, where it caused widespread damage; and the red turnip beetle [*Entomoscelis adonidis*, Pall.], which attacked crucifers in the park belt and adjacent prairies. Some injury to garden plants and other crops was caused by migrating larvae of the beet webworm [*Loxostege sticticalis*, L.], which occurred in great numbers on weeds in several localities in the north-west and north-central districts. The western chinch bug [*Blissus occiduus*, Barber] was recorded for the first time since 1923 as doing slight damage in one locality. Say's grain bug [*Chlorochroa sayi*, Stål], which in recent years has been a serious pest of wheat in northern Montana [24 161] was found, for the first time in Saskatchewan, in small numbers in the south-west.

VENABLES (E. P.) & HERIOT (A. D.). **The Blister Mite of Apple and Pear.**—*Publ. Dep. Agric. Canada* no. 577, 3 pp., 4 figs. Ottawa, May 1937. [Recd. December 1937.]

Brief notes are given on the bionomics and control of the blister mite, *Eriophyes pyri*, Pgst., on pear and apple trees in British Columbia. It was first recorded there in 1894 and is now generally distributed throughout the fruit-growing sections of the province. There appear to be two races [*cf. R.A.E.*, A 20 685] similar in appearance; one attacks pear and is probably of European origin, and the other is apparently indigenous on wild mountain ash [*Sorbus americana*] and now also attacks apple and English rowan [*S. aucuparia*]. The latter race is much the more resistant to extremes of cold.

The adult males and females overwinter under the bud scales, becoming active in April when the buds begin to swell. The males die soon after pairing, and the females live until they have deposited their eggs at the base of the expanding buds. As the leaves unfold the eggs hatch; the mites of this generation cause most of the damage to the fruit and foliage. They are larger than any of their descendants, and each one produces a large number of blisters, in which the later generations breed. Some of the mites remain in the blisters until the autumn, though others return in late July to the buds where they will hibernate.

The way in which the blisters are produced on the leaves is briefly described [23 420]. They at first appear as pale greenish spots; later the leaves turn brown and early defoliation results. The blisters are more conspicuous on undeveloped apples, but most of the injury to fruit is outgrown, although in severe cases extensive russetting and cracking may occur. The mites may be controlled by spraying with lime-sulphur (1 : 15) before the buds begin to open. Applications should be thorough as, at this stage, all the mites are beneath the bud scales. Spraying after the leaves have appeared is not satisfactory, although it does effect some measure of control, particularly in the case of the mites outside the blisters.

SCARAMUZZA (L. C.). **Notas sobre un complejo extraordinario de parasitismo. El *Apanteles americanus* Lepeltier.** [Notes on an extraordinary Complex of Parasitism. *A. americanus*, Lepeltier.]—*Mem. Soc. cub. Hist. nat.* 11 no. 4 pp. 267-268. Havana, October 1937.

The Braconid, *Apanteles americanus*, Lep. (which has often been erroneously identified as *A. flaviventris*, Cress.) parasitises the Sphingids, *Erinnyis ello*, L., and *E. alope*, Dru., which infest papaya and *Manihot* spp., including cassava, in Cuba. It is itself attacked by several hyperparasites, viz., the Chalcidoids, *Elasmus maculatus*, How., *E. punctulatus*, How., *Eurytoma walshi*, How., *Horismenus apantelivorus*, Crwf., *H. cockerelli*, Crwf., and *Eupelmus* sp., and the Ichneumonid, *Stiboscopus thoracicus*, Ashm.

CROWLEY (D. J.). **The cultivated Cranberry in Washington.**—*Bull. Wash. St. agric. Exp. Sta.* no. 349, 46 pp., 10 figs., 4 refs. Pullman, Wash., July 1937. [Recd. December 1937.]

This bulletin includes a section (pp. 21-33) on the insect pests of cultivated cranberry (*Vaccinium macrocarpon*) in Washington State. Many of them are easily controlled by flooding the bogs [*R.A.E.*, A 21 454], but this is not widely practicable in Washington.

The most important in the south-western area is *Rhopobota naevana*, Hb. (*vacciniana*, Pack.), the egg, larval and adult stages of which are briefly described. There are normally two generations a year, and a partial third in very warm seasons. Winter is passed in the egg stage, and larvae appear in April-May and the first half of July, feeding on foliage and fruit. The larval stages in the two generations last about 45 and 30 days, respectively, and the pupal stage about 2 weeks. Satisfactory control is given by sprays of nicotine sulphate and pyrethrum, but a cheaper and equally effective spray is a mixture of derris, stabilised nicotine and a wetting agent, containing about 3 per cent. actual nicotine, which is diluted at the rate of 6 lb. per 100 U.S. gals. water and applied at the rate of 300-400 U.S. gals. to an acre of bog at weekly intervals during hatching. Good control is also obtained with dusts of either rotenone or pyrethrum and talc at the rate of 30 lb. per acre.

Mineola vaccinii, Riley, causes considerable damage to fruits in seasons with high temperatures in July and August. It has one generation a year and the larvae overwinter in débris. Adults emerge from early June to early August, and females oviposit in the blossoms or calyx cups. The best results in control are obtained by spraying against the adults, with nicotine sulphate (1:300) or pyrethrum. Two applications are usually required, the first as soon as the moths appear; adults of *Rhopobota*, which are usually present at the same time, are also killed.

The scale insect most harmful to cranberry is *Aonidiella* (*Aspidiotus*) *perniciosa*, Comst., which chiefly attacks the stems and has two generations a year. Some control is given by flooding the bogs in winter, and the results are much improved if a 95 viscosity spray oil is slowly added to the inflowing flood water at the rate of 10 U.S. gals. per acre. The water is allowed to rise till only the tips of the vines are exposed and is drained off after a few weeks; it leaves a film of oil on the plants, which are in no way harmed. Where this method cannot be used, a 10 per cent. spray of lime-sulphur applied as late as possible before spring growth gives the most satisfactory control. When the young scales have not yet settled they can be destroyed by flooding (provided that the cranberries are not in full bloom) or by an emulsion of 1 quart each of a thiocyanate (Lethane 440 [24 731]) and tank-mix oil (viscosity 60 seconds Saybolt) in 100 gals. water or a 1 per cent. spray of light oil in combination with a contact insecticide. The thiocyanate spray can be applied 3 times without injuring the plants or berries. Other Coccids attacking cranberry are *Aspidiotus ancylus*, Putnam, and *Lepidosaphes ulmi*, L., which have one generation annually. They may be controlled by the same measures as *A. perniciosa*.

Dasyneura vaccinii, Smith, which infests the growing tips of cranberry in one district, has 2 generations a year, of which the second in July is the more injurious. It is usually controlled by the sprays applied against *Rhopobota*. Among root weevils, the most important is *Otiorrhynchus* (*Brachyrrhinus*) *sulcatus*, F., of which the larvae girdle the roots in early spring. The adults may be controlled by poisoned baits consisting of 5 lb. calcium arsenate in 100 lb. dried apples or raisins. Other pests of cranberry include larvae of *Orgyia* (*Notolophus*) *antiqua*, L., and several species of cutworms. The cranberry girdler (*Crambus hortuellus*, Hb.) occurs in Washington, but is not of economic importance there.

BALDUF (W. V.). **Bionomic Notes on the Common Bagworm, *Thyridopteryx ephemeraeformis* Haw., (Lepid., Psychidae) and its Insect Enemies (Hym., Lepid.).**—*Proc. ent. Soc. Wash.* **39** no. 7 pp. 169–184, 3 figs., 49 refs. Washington, D.C., November 1937.

An account is given of the insect enemies and hyperparasites of *Thyridopteryx ephemeraeformis*, Haw., found in Illinois in 1932 and 1936, together with some data from the literature on them, and of incidental observations by the author on the egg-laying capacity of the moth and the effect of abnormally low winter temperatures on the survival of the eggs. Parasites that are recorded apparently for the first time in association with *T. ephemeraeformis* include *Pimpla (Epiurus) indagatrix*, Cress., which attacks the pupae, and *Habrocytus thyridopterigis*, Ashm., which is a hyperparasite.

EWING (H. E.). **A new Eriophyid Mite from Lemon Trees (Acarina: Eriophyidae).**—*Proc. ent. Soc. Wash.* **39** no. 7 pp. 193–194, 1 fig. Washington, D.C., November 1937.

A description is given of *Eriophyes sheldoni*, sp. n., from lemon trees in California. Observations by E. A. McGregor show that the mites infest the buds, causing deformation of the ends of the twigs. Another species of *Eriophyes* was found on *Salvia* in the same locality.

HARTZELL (A.). **Bionomics of the Plum and Peach Leafhopper, *Macropsis trimaculata*.**—*Contr. Boyce Thompson Inst.* **9** no. 2 pp. 121–136, 4 figs., 36 refs. Yonkers, N.Y., 1937.

An account is given of the bionomics of *Macropsis trimaculata*, Fitch, the insect vector of peach yellows and little peach in the north-eastern United States and in southern Canada [cf. *R.A.E.*, A **23** 603; **24** 298], and all stages are described. This Jassid has been recorded only from North America, but may possibly have been introduced from eastern Asia on Japanese and Chinese plums (*Prunus salicina* and *P. simonii*), which are preferred food-plants. *P. americana* is the principal wild food-plant, but several other species of the genus are also attacked. Infestation has also been recorded on apricot, nectarine and grape-vine. It was first reported on peach in 1927, and when adults collected from *P. americana* were subjected to selective feeding tests with peach and wild plum, 60 per cent. preferred peach twigs. The mortality of nymphs was, however, considerably higher on peach twigs than on plum.

The technique used in life-history studies at Yonkers (New York) is described. The eggs are deposited in twigs in July and August, and overwinter [cf. **21** 192]. When young, the nymphs conceal themselves between the unfolding leaves; later they occur on the twigs and branches. From 1933 to 1937, inclusive, the earliest dates on which nymphs were observed in the field were 8th June, and 28th, 30th, 25th and 26th May. There are 5 nymphal instars. The total nymphal period for 500 individuals observed under field conditions lasted 21–35 days. Adults were found from 15th June to 17th August, but pairing, which occurs several days before oviposition, was not observed until 13th July. Adults lived 11–51 days in captivity, with an average of 25. There was no evidence of a second generation. Population studies at Yonkers showed that the Jassids were more abundant in June 1934 than at any other period during the investigations, although

the eggs had been exposed to an unusual degree of cold as the temperature had dropped to -6°F. in the previous December. The population was lowest in 1936, probably on account of exceptionally heavy rainfall in early June.

Attempts to rear the nymphs at constant temperatures of 5, 10, 15, 20 and 25°C. [41, 50, 59, 68 and 77°F.] were successful only at 20°C. , and at this temperature the nymphal period was prolonged, lasting 38–74 days, so that alternating temperatures are probably more favourable for development.

MARSHALL (James). **Inverted Spray Mixtures and their Development with Reference to Codling Moth Control.**—*Bull. Wash. St. agric. Exp. Sta.* no. 350, 88 pp., 13 figs., 3 pp. refs. Pullman, Wash., 1937.

The following is based on the author's summary of results of experiments that have been carried out in Washington since 1933 on the properties of inverted sprays containing lead or other arsenates that are used for the control of codling moth [*Cydia pomonella*, L.] on apple: Early application of inverted sprays of lead arsenate have controlled codling moth infestations in a district where 2–4 generations occur. Methods of making the inverted spray mixtures are discussed [cf. *R.A.E.*, A **25** 419, 652]; about 4 U.S. pints oil and 4 oz. univalent soap have been necessary for the inversion of 3 lb. lead arsenate in 100 U.S. gals. water. The amount of soap required for calcium arsenate has been more variable. The most satisfactory soaps have been triethanolamine oleate and ammonium oleate. The agent effecting the inversion of arsenical spray mixtures [25 419] may be a fatty acid, such as oleic acid, a uni-, di- or trivalent soap, or some other fatty acid compound, such as diglycol oleate, all of which promote the wetting by oil of the arsenical, usually preferentially wetted by water. In inversion produced by univalent soaps or free fatty acids, it is believed that oil-wetting is due largely to the formation of di- or trivalent soaps that are soluble or preferentially wetted by oil. The solids deposited in a film on the fruit by inverted sprays increase steadily as spraying is prolonged upon one point, apparently because the solid particles are coated with a film of the oil but are not loosely dispersed in it. Wetting and adhesive qualities are important in the formation of this film, but apparently not the spreading qualities. Inverted mixtures have been made with lead arsenate, synthetic and natural cryolite, commercial calcium arsenate and zinc arsenate as the solid, and it appears probable that any finely divided solid (whether insecticide or fungicide) that is almost insoluble in water and oil might be employed in this manner. Inversion may be strongly influenced by impurities in the solid insecticide, oil, water or oleic acid, and the admixture of fungicides would need further investigation.

Hydrophilic colloids such as ammonium caseinate exert a strong stabilising effect upon inverted mixtures. Zinc sulphate stabilises the mixture when added at the rate of about 2 oz. or more per 3 lb. lead arsenate (and more for calcium arsenate mixtures), but at the rate of 0.25–0.5 oz. it destabilises the mixture. Destabilisation may also be promoted by increasing the soap content of the spray or introducing free fatty acid. Agitation in the tank should be the minimum necessary to prevent the flocculence settling to the bottom and overflow should

also be at a minimum or else the emulsion breaks in the tank with the adhesion of oil and solid to the sides of the tank.

The ovicidal effect of inverted mixtures appears to be slightly less than that of non-inverted mixtures, probably because less of the oil is available to coat the eggs. In moderate applications, inverted spray mixtures have given heavier deposits and better control of the codling moth than non-inverted mixtures containing the same amount of oil, but in heavier applications the inverted mixtures are proportionately very much more effective than non-inverted ones, for all the oil and solid constituents of inverted sprays remain on the fruit, while with uninverted sprays no suspended solids adhere once the fruit has been wetted with water. Inverted arsenical mixtures made with highly refined, light to medium summer petroleum oil tend to form relatively large agglomerates of solid particles on the fruit surface. The size of these depends to a considerable extent upon the type of oil used and the ratio of oil to solid in the spray. The particles, particularly in the case of calcium arsenate sprays, may be so large that newly hatched larvae of the codling moth cannot ingest them. The presence of oil appears to decrease fissuring of the deposit and weathering, particularly in inverted mixtures, but kerosene has no effect in this way. Under arid conditions, there is considerable loss from weathering of non-oily deposits, but no loss from weathering has occurred from deposits from inverted sprays. There is, however, some decrease owing to fruit growth. Four applications containing 0.5 per cent. summer petroleum oil, applied during May and June, have not caused obviously deleterious effects to fruit or foliage of apple in one district under arid conditions. Mixtures containing petroleum oil should not be applied later than July; residues resulting from these sprays are high and removal problems are increased. The cost of controlling codling moth by inverted mixtures is less than by any other available spray. Commercial calcium arsenate in the form of an inverted mixture with the addition of a small but variable amount of zinc sulphate as well as univalent soap and summer oil [*cf.* 24 319] is a promising spray for eliminating lead, but further investigations on it are necessary.

SQUIRE (F. A.) & BRIANT (A. K.). **Spotting of Bananas caused by *Frankliniella insularis* (Franklin).**—*Trop. Agriculture* 14 no. 12 pp. 351–352. Trinidad, December 1937.

The cultivation of bananas on a commercial scale was begun in St. Vincent in 1934. In December 1936, a large proportion of the fruit from some of the more recently planted areas was badly spotted, and in subsequent shipments the spotting increased. It was found to be caused, at a very early stage of the development of the fruit, by the oviposition of *Frankliniella insularis*, Franklin. Eggs were found in fruit up to 4 ins. in length. The spotting was worst where the bananas were planted near sword beans (*Canavalia ensiformis*), *Gliricidia* and pigeon peas (*Cajanus indicus*), which are food-plants of *F. insularis* and on which it usually oviposits, but in this case, the leguminous plants bore no marks of oviposition, the thrips having apparently preferred the young bananas on account of their sheltered position within the flower bracts and their succulence. When the leguminous plants were removed from the vicinity of the bananas, the spotting practically ceased.

MOUTIA (A.). **Entomological Division.**—*Rep. Dep. Agric. Mauritius 1936* pp. 37-39. Port Louis, 1937.

In October-December 1936, adults of *Lachnosterna* (*Phytalus*) *smithi*, Arr., were collected in smaller numbers than in the corresponding period of 1935 [cf. *R.A.E.*, A 25 601], even when allowance is made for the fact that a third of the estates concerned had ceased hand-collection of the beetles. No recoveries in the field have been made of a Tachinid parasite of *Enaria melanictera*, Klug, introduced from Madagascar against *L. smithi* [25 789], or of the Encyrtids, *Spaniopterus crucifer*, Gah., and *Comperiella unifasciata*, Ishii, introduced from Java for the control of *Aspidiotus destructor*, Sign., on coconut.

In some estates on the coastal belt, both in the north and south, sugar-cane was severely attacked by *Diatraea venosata*, Wlk. In 7,300 canes from different localities, the percentage infestation of stalks and internodes averaged 23.8 and 12.6. *Corcyra cephalonica*, Stn., was found to be a suitable local host for the mass-breeding of *Trichogramma australicum*, Gir. Its life-cycle in November and December averaged 48 days. Several generations of *T. australicum* were reared on it, the life-cycle of the parasite being completed in 9 days.

SMITH (A. J.). **Gas Concentration. Comparative Studies with different Citrus Fumigants.**—*Fmg in S. Afr.* 1937 repr. no. 80, 4 pp. Pretoria, August 1937. [Recd. December 1937.]

Experiments were carried out in South Africa on the distribution in fumigation tents of hydrocyanic acid gas derived from sodium cyanide and sulphuric acid (pot method), liquid HCN, a dust containing 40-50 per cent. calcium cyanide and briquettes containing 88.5 per cent. calcium cyanide, all of which are extensively used against Coccids on *Citrus*. The tents were drawn over special forms, and, in each experiment, measured samples of the air-gas mixture were aspirated from each of 5 points $\frac{1}{2}$, 5, 10, 15, 30 and 35 minutes after application of the fumigant. Comparison was based on the recommended dosages of each fumigant for commercial practice. Four tests were made with each of the four fumigants under both day and night conditions. Air temperatures during the experiments ranged from 50 to 60°F.; inside the tents, temperatures at the top were 10-20° higher during the day and 2-5° lower during the night than the ground-level temperatures.

The results are shown in tables. Average concentrations of gas in gm. per cu. m. throughout the tent for the 35 minutes' exposure ranged from 0.751 to 0.398 by day and from 1.014 to 0.426 by night, and were given, in descending order, by the pot method, the briquettes, liquid HCN and the calcium cyanide dust [cf. *R.A.E.*, A 26 117]. The initial concentrations given by the pot method were very erratic; at night the gas appeared to rise to the top of the tent at once, whereas during the day the greatest initial concentration was in the centre. Five minutes after application, the gas was evenly distributed and concentrations in every part of the tent were high enough to have ensured a good kill of scale insects. Liquid HCN was applied as a finely-divided mist. When the ground temperature was higher than the air temperature, the gas tended to remain in the lower part of the tent. Over the whole series of experiments, the average initial concentrations by this method were high, but by the end of the exposure the concentration was lower than in tents fumigated by other methods.

At night the gas was evenly distributed 5 minutes after application and gave a satisfactory concentration throughout the tent, but during the day the average concentration was erratic, was 35·4 per cent. lower than that obtained by night and was not great enough to ensure reliable control. The calcium cyanide briquettes were ground up and the dust blown into the tent; HCN was liberated as soon as the particles came into contact with the moisture in the air. The gas was most evenly distributed by this method, and concentrations during the day and night were always great enough to ensure a good kill. The 40–50 per cent. calcium cyanide dust, which was blown into the tent, gave lower initial and average concentrations of gas than those obtained with the other forms of fumigant, but the concentrations varied less over the period of exposure. This is probably due to the slower liberation of the gas and the smaller leakage owing to lower concentrations.

SMITH (A. J.). **Aphids in Tobacco.**—*Fmg in S. Afr.* 1937 repr. no. 88, 2 pp., 1 fig. Pretoria, September 1937.

Serious injury to tobacco in South Africa has been caused in recent years by the peach aphid [*Myzus persicae*, Sulz.]. Seed beds should be sprayed or dusted with nicotine once a week to prevent infestation and the transplanting of infested plants. Infestation in the field usually begins on the lower surface of the lowest leaves. When the plants are about a foot high all the lower leaves should, therefore, be stripped to a height of at least 6 inches from the ground, and where infestation occurs the leaves should be exposed as much as possible so that the Aphids will be killed by the sun. Immediately after stripping, a nicotine dust should be carefully applied to the lower surface of the remaining leaves of any infested plants. Some varieties of tobacco are more susceptible to attack than others.

MUNRO (J. W.). **Cotton Pest Control Work in southern and central Africa and the Rhodesias. Report on a Tour undertaken . . . March-July, 1937.**—Med. 8vo, 37 pp., 1 ref. London, Emp. Cott. Gr. Corp., 1937. Price 2s. 6d.

In 1937, the author visited the plantations of the Empire Cotton Growing Corporation in South Africa, Nyasaland, and Northern and Southern Rhodesia and made a detailed survey of the investigations in progress on the control of pests of cotton [*cf. R.A.E.*, A 25 359–363, etc.]. This report deals with the work of the individual stations and includes a general discussion of it as a whole. It is concluded that the present investigations are on the right lines and that very good progress has been made; ways in which work should be continued and extended are suggested.

KIRKPATRICK (T. W.). **Studies on the Ecology of Coffee Plantations in East Africa. II. The Autecology of *Antestia* spp. (Pentatomidae) with a particular Account of a Strepsipterous Parasite.**—*Trans. R. ent. Soc. Lond.* 86 pt. 14 pp. 247–343, 40 figs., 2 pp. refs. London, December 1937.

The synonymy and distribution of the various species of *Antestia* occurring on coffee in East Africa are discussed. The author believes

that there are five distinct species, one of which is definitely identified as *A. trivialis*, Stål, and the others tentatively determined as *A. lineaticollis*, Stål, *A. faceta*, Germ., *A. falsa*, Schout., and *A. usambarica*, Schout. Brief notes on the size and colour and the probable distribution of each are given. The life-history of *A. lineaticollis* is summarised from the work of various authors [*R.A.E.*, A 7 259, 405; 12 264; 24 648] with the addition of observations on individuals kept separately in the laboratory in small celluloid cylinders standing on blotting paper and covered with a glass plate, and fed on full-sized green coffee berries. In Tanganyika, the egg stage lasted 5–6 days in February and March (average temperature 23.5°C. [74.3°F.]) and 8–10 days in June–August (19.2°C. [66.56°F.]). Data on the duration of the instars are presented in tables; experiments in the incubator suggest that constant and rather high temperatures may retard development. The life-history and habits of *A. faceta*, *A. trivialis* and *A. falsa* are similar except that the duration of the nymphal stages of *A. trivialis* and *A. falsa* is a few days longer, and of *A. faceta* a few days shorter, but the difference may not be significant.

Food and feeding habits are discussed. The author concludes that *Antestia* will breed only on plants of the order Rubiaceae and that *Coffea arabica* is the favourite food-plant. Full-sized green berries were more suitable food than either ripe or young berries, which increased the development period and decreased the length of adult life and the fecundity of the females. Neither nymphs nor adults were kept alive in the laboratory when fed on leaves, flower buds or very young berries only, or on small plants growing in pots, but nymphs on similar potted plants out of doors were reared to the adult stage; development was, however, slower than on a branch bearing berries only. Dew and rain probably aided survival. The apparent discrepancy between the conclusions of various workers on the order of preference for the various parts of the plant may probably be accounted for by a difference of humidity in the districts concerned. It is generally agreed that the principal injury caused by *Antestia* is the spotting and pitting of the beans due to the bugs sucking the developing berry. The younger the berries are attacked, the greater is the harm done. If *Nematospora* is introduced, the bean is completely destroyed. Besides *A. lineaticollis*, *A. faceta* and *A. trivialis* and perhaps other species are vectors. In the absence of berries, the young shoots are attacked, and short secondary and tertiary branches bearing no crop may be a result of this.

In any one district, eco-climatic factors exercise an appreciable influence on the abundance of *Antestia*. At higher altitudes, where the nights are cold, the bugs are more numerous in the less cold shaded plantations. They probably also require the protection of shade at low altitudes where the day temperature is exceptionally high. In the intermediate districts, they thrive best in unshaded plantations, where the higher day temperatures probably have more effect in increasing the rate of reproduction than have the higher night temperatures in shaded plantations. The effect of shade may be due to the fact that it raises the humidity of the air by day and decreases the deposition of dew at night, for though the bugs thrive in a dry atmosphere, there is evidence that they then require moisture to drink. The low humidity caused by the proximity of windbreaks competing for moisture may increase damage by making them feed on juicy young berries.

The natural enemies are discussed from the literature. Those observed by the author in Tanganyika include a Braconid, probably of the genus *Helorimorpha*, the female of which oviposits in the nymphs of *A. lineaticollis*. Usually only one egg is laid in each nymph, and not more than one has been known to hatch. The duration of development from oviposition to emergence of the mature larva varies considerably, lasting 16–65 days in the laboratory, and the period spent in the cocoon, which is usually spun in loose earth, lasts 17–21 days. Pairing takes place almost immediately after emergence; parthenogenesis produces males.

The greater part of the paper is devoted to the study of the Strepsipterous parasite of *A. lineaticollis*, *Corioxenos antestiae*, Blair [cf. **24** 188, 558; **25** 95], a full description of which is given to supplement the original one. Its bionomics are dealt with in great detail. The terms used include triungulin for the free-living campodeiform larva, maternal host for one containing a female that is producing triungulins, and potential host for a nymph to which triungulins are attached externally. They cannot penetrate the nymph until it moults. The triungulins live on the maternal host for periods varying from a minute to several days. They lived without a host in the laboratory for as long as 19 days. The longest time for which one is known to have survived on a potential host and then completed its development is 34 days, but the percentage that develops decreases rapidly after 20 days. At 20–26°C. [68–78.8°F.], the parasitic larval instars, which are thought to be six in number, lasted altogether about 30 days, but this period could be prolonged to twice the normal length if delay in the final ecdysis of the host prevented extrusion of the cephalothorax. The pupal stage of the male lasts about 12 days and the active adult life only 2 or 3 hours. A female becomes capable of being fertilised about 7 days after extrusion, and remains so for 5–8 weeks, after which the ova degenerate. Parthenogenesis never occurs. The incubation period from fertilisation to the emergence of the triungulins is usually 6–9 weeks, varying with temperature. A single female can produce over 3,500 triungulins, during a period of about 3 months. It is impossible to recognise parasitised hosts. Parasitisation does not affect the duration of the immature stages, but slightly reduces the length of adult life. Parasitised females, are, however, invariably infertile, as are most parasitised males. Some of the males parasitised in the fifth instar or as adults were not completely sterile, but females fertilised by them did not lay a normal number of viable eggs. There appears to be a tendency for the rate of parasitism to fall during the cold season. It probably follows, with a time lag of about two months, the abundance of the host. The parasitisation by *C. antestiae* of species of *Antestia* other than *A. lineaticollis* and the comparative immunity of individuals with malformed antennae [cf. **25** 95], and the importance of a fungus, *Penicillium* sp., sometimes found associated with the parasite in its host, which is thought to be slight, are discussed.

The activity of *C. antestiae* on the slopes of Kilimanjaro is not sufficient to exercise effective control without the assistance of artificial methods, but it is valuable as it reduces the fecundity of the host population by some 40 to 50 per cent. Sodium arsenite bait-sprays [cf. **23** 143, etc.] are particularly suited for use where it occurs, as the triungulins can emerge unaffected from hosts that are dying or even dead from the effect of the spray, which on the other hand kills large numbers of Hymenopterous parasites. Arsenic sprays are more

effective in districts in which it is present than elsewhere. Pyrethrum as a spray or dust [24 649, etc.] would probably destroy triungulins on the bush and not allow of many escaping from maternal hosts, as its action is much quicker than that of the poison bait. To supplement biological and artificial control, the modification of the eco-climate by providing shade except at very high or very low altitudes, growing a cover crop, and avoiding windbreaks if possible, and the adoption of a system of pruning that reduces intermittent flowering to a minimum are recommended.

VOLKONSKY (—). **Sur l'action acridifuge des extraits de feuilles de *Melia azedarach*.**—*Arch. Inst. Pasteur Algér.* **15** no. 3 pp. 427–432, 2 refs. Algiers, 1937.

Most of this information on the use in Algeria of sprays made with extracts from the leaves of *Melia azedarach* for protecting plants from the attacks of locusts has been summarised elsewhere [*R.A.E.*, A **25** 670]. The active principle involved appears to be a derivative of paraïsin and is not destroyed when the leaves are dried at 37°C. For practical purposes the extract can be most cheaply prepared in methylated spirit in a continual extraction apparatus; it should be evaporated to $\frac{1}{6}$ of the weight of dry leaves under reduced pressure, and 20 per cent. of glycerine should be added to facilitate emulsion. Water should be added just before the spray is used.

Since the spray must be uniformly distributed over the plants, it should be used for those that are valuable enough to justify very careful spraying. In July–August, a *Melia* tree 26–27 ft. high should yield 7 cwt. (dry weight) of leaves, from which sufficient extract can be obtained to spray 50–150 acres of vine. At the concentrations used [*loc. cit.*], the spray has no repellent or toxic effect on mammals; guineapigs, rabbits, sheep and a calf were fed for 15 days on heavily sprayed grass without any ill effects.

BOUET (G.). **Nouvelles recherches sur les cigognes blanches de l'Afrique du Nord.**—*Oiseau* 1938 no. 1 repr. 26 pp., 1 map, 3 refs. Paris, 1938.

Following investigations on the effect of locust poisoning operations on the stork population in Algeria [*R.A.E.*, A **24** 637], similar work was carried out in French Morocco. Although the stork populations decreased in certain areas during the anti-locust campaigns in 1930–1933, they have since then reached the original level. It appears that storks avoid feeding on dead poisoned locusts, and regurgitate the poisoned live ones if they happen to swallow them.

HUSAIN (M. A.) & BHALLA (Hem Raj). **The Bird Enemies of the Cotton Leaf Roller (*Sylepta derogata* Fb.) at Khanewal, Multan (Punjab).**—*Indian J. agric. Sci.* **7** pt. 5 pp. 785–792, 2 refs. Delhi, October 1937.

An annotated list, showing the results of analysis of stomach contents, is given of 36 species of birds belonging to 17 families that were observed to feed on larvae of *Sylepta derogata*, F., during a serious infestation on American cotton in the Punjab in 1933–34. Of these, 12 species were of considerable importance, the most effective being the Himalayan starling (*Sturnus vulgaris humii*), individuals of which ate

on an average 162 larvae a day. The population of larvae in one field was reduced from 267 to 3.3-5.1 per sq. yd., largely by birds. Poultry also fed on the larvae.

PRUTHI (H. S.) & BHATIA (H. L.). **A new Cecidomyid Pest of Linseed in India.**—*Indian J. agric. Sci.* **7** pt. 5 pp. 797-808, 2 pls. (1 col.), 22 refs. Delhi, October 1937.

Dasyneura lini, Barnes, which infested the flower-buds of flax (linseed) at Pusa in 1933 and the following seasons [*R.A.E.*, A **25** 50, 529], was also found to be present in them in Karnal, and is probably widely distributed in India. The immature stages of this Cecidomyiid are described, and Barnes' description of the adults is quoted. At Pusa, where a detailed study of it was made, the adults are first seen in the field in early January, and the females start ovipositing soon afterwards, principally between 11 a.m. and 3 p.m. Males are commonly observed in the late afternoon and evening. Both sexes are attracted to light in small numbers. Eggs were found in the field up to the third week of February. It is thought that three generations were completed between the beginning of January and mid-March; soon after this all varieties of flax were mature and the pest disappeared. In the laboratory, most of the larvae at this time went under soil débris, formed a thin silken cover and entered a quiescent stage, though a few pupated. It is probable that activity is resumed soon after the rains or at the beginning of autumn. The food-plants from this time to the end of December, when flax buds become available, have not been ascertained. Young larvae of the Cecidomyiid from *Cajanus indicus* [25 529] completed their development on flax, and larvae from flax completed development on *C. indicus*, but attempts have not yet been made to inter-breed individuals from the two plants.

The egg, larval, pupal and adult stages in a laboratory with minimum and maximum temperatures of 72° and 77.5°F. lasted 1-2, 5-8, 4-6 and 4-6 days, respectively. The eggs are laid singly or in loose batches of 3-5 within the folds of the calyx of the young flower-buds. Usually 2-4 and in some cases as many as 10 larvae were found in a single bud. As a result of their feeding, the corolla becomes crumpled and the internal organs shrivelled. Pupation takes place in a cottony cocoon beneath the soil and begins almost as soon as the cocoon is formed, except when the larva enters the long quiescent period in a thin cover. In the laboratory, larvae sometimes pupated without forming a cocoon, and the pupae gave rise to normal adults. Differences in the susceptibility to attack of various varieties of flax are discussed.

PONCE (A.). **The Melon Fly (*Dacus cucurbitae* Coquillet).**—*Philipp. J. Agric.* **8** no. 3 pp. 289-309, 4 pls., 2 charts, 17 refs. Manila, 1937.

Notes from the literature are given on the distribution and food-plants of *Dacus cucurbitae*, Coq., and all stages are described. In the Philippines, the author found it infesting 7 species of cucurbits, egg-plant (*Solanum melongena*) and tomato. It has previously been also recorded there from fruits of guava, mango, *Anona* spp., papaya, cowpea and *Passiflora*. In life-history studies, the flies were reared in

battery jars. Each jar contained a small dish lined with blotting paper on which was placed an inverted vial of water slightly sweetened with brown sugar. Sliced fruit was provided for oviposition. The incubation period lasted 0·5–4 days, averaging 1·73. The larvae feed inside the fruit. When mature they drop to the ground and pupate at a depth of 3–7 inches or, if the soil is very hard, beneath objects on the surface. At an average temperature of about 30°C. [86°F.], the larval period lasted 4–9 days, being rather shorter in papaya than in cucurbits, and the pupal period 7–11. The flies usually emerged in the early morning and the sexes occurred in about equal numbers. Pairing usually took place between 6 p.m. and 9 a.m. The pre-oviposition and oviposition periods lasted 7–26 and 39–95 days, and averaged 15·9 and 53·6 days, respectively. One female laid a total of 494 eggs and another laid 45 in one day. Under laboratory conditions, males and females lived 30–90 and 36–143 days, with averages of 60·8 and 70·9. In tests with poisoned sugar solutions, white arsenic and sodium arsenite were more toxic to the flies than copper sulphate, lead arsenate or calcium arsenate. The percentages of mortality in flies fed on a 1·5 per cent. solution of brown sugar poisoned with 0·2 per cent. sodium arsenite or 0·1 per cent. white arsenic were, respectively, 20 after 6 and 26 hours, 40 after 10 and 38 hours, 80 after 20 and 44 hours, and 100 after 29 and 53 hours. Field tests of these baits have not been made.

DE FLUITER (H. J.). **Waarnemingen omtrent de witte luis-bestrijding.** [Observations on the Control of White Mealybugs.]—*Bergcultures* **11** no. 27 pp. 995–999. Batavia, 1937.

In the control of the white mealybugs of coffee in Java, it is necessary to differentiate between *Ferrisia* (*Ferrisia*) *virgata*, Ckll., and *Pseudococcus citri*, Risso, and also between plantations below and above an altitude of about 2,000 ft.

Lamtoro [*Leucaena glauca*] is the primary food-plant of *F. virgata* in both zones, and of *P. citri* in the high land, but coffee is the primary food-plant of the latter in the low land. To control *F. virgata*, it is necessary to eliminate the first individuals that appear on *Leucaena* by removing the infested parts, chiefly the flower clusters. In the high land this measure should be applied also against *P. citri*, but the pruning must be more extensive, as infestation is not so localised. If *F. virgata* is already present on Java coffee when *Leucaena* is being pruned, sprays can be applied with success, as the mealybug is exposed on the leaves and on the open long-stemmed clusters. Spraying on Robusta coffee, which has close clusters, is less effective. *P. citri* in the low and high lands can be controlled by chemical or chemical-mechanical measures on Java coffee, but not on Robusta. Both mealybugs can be controlled in both zones by intensifying the shade, using such shade plants as dadap [*Erythrina*] or *Albizia*, which are not attacked.

GUILLAUME (A.) & PROESCHEL (Mlle). **Études de plantes à roténone: procédés de dosage.**—*Rev. Bot. appl.* **17** no. 194 pp. 737–743, 4 refs. Paris, 1937.

Analysis showed that roots of *Lebeckia retmoides* from Madagascar, and pods of *Parkia africana* from French West Africa contained no

rotenone. Roots of *Mundulea pauciflora* from Madagascar, contained 1.25–1.90 per cent. according to size of the roots (bigger ones containing a greater percentage); and roots of *Derris elliptica* from Indo-China and of *D. malaccensis* contained 2.94 and 6.04 per cent., respectively. Different samples of the powdered roots were extracted with ether, chloroform, carbon tetrachloride and acetone; in all cases acetone extracted a greater percentage of material, in the case of *Parkia* pods 10 times as much as other solvents. The authors describe their method of extracting rotenone-containing roots with ether and crystallising pure rotenone by the addition of ice-cold ether. They state that by this method all the rotenone in the extract is precipitated; the rotenone content and the ether extract are both measured in the same determination, which is easily carried out and is accurate.

Nederlandsch Insecten en Derris in 1936. [Netherlands Insects and Derris in 1936.]—*Tijdschr. PlZiekt.* **43** no. 11 pp. 251–265, 2 pls. Wageningen, November 1937.

Tests of derris on insects in Holland were continued in 1936 in the field and in the laboratory; the list of insects in 5 categories of susceptibility [*R.A.E.*, A **24** 518] is revised to include the data obtained.

In 1934, derris dust had proved effective against *Nygmia phaeorrhoea*, Don [**23** 256]. Further tests were made in 1936, including one on 12th and 13th May with a 1 per cent. derris dust mixture against larvae that had just left their winter nests on hawthorn and oak. An excellent result was obtained except on tree-tops beyond reach of the dust. A 0.5 per cent. mixture proved very satisfactory for field use against *Diprion (Lophyrus) pini*, L., on pines. Undiluted derris powder (3 per cent. rotenone) dusted in the hiding places of cockroaches gave good results against the nymphs and adults. The eggs were not affected, so that dusting should be repeated a few times at intervals of 3–4 weeks. It was found experimentally that *Calandra granaria*, L., *Tribolium castaneum*, Hbst. (*ferrugineum*, F.), and larvae of *Ephestia elutella*, Hb., were insensitive to derris, but *Gnathocerus cornutus*, F., and larvae of *Borkhausenia pseudospretella*, Staint., were susceptible to a derris powder with 1 per cent. rotenone.

PAPERS NOTICED BY TITLE ONLY.

WORSLEY (R. R. Le G.) & NUTMAN (F. J.). **Biochemical Studies of *Derris* and *Mundulea*. I. The Histology of Rotenone in *Derris elliptica*.**—*Ann. appl. Biol.* **24** no. 4 pp. 696–702, 2 pls., 2 figs., 1 ref. Cambridge, November 1937.

SMITH (C. R.). **Occurrence of *l*-Nornicotine in *Nicotiana sylvestris*.**—*J. econ. Ent.* **30** no. 5 pp. 724–727, 10 refs. Menasha, Wis., October 1937.

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